

OCTOBER  
1959

PRICE 75 CENTS

# ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

IMPACT  
OF  
NEW

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LIGHTING  
LEVELS

ON  
RELATED  
DESIGN

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59TH YEAR



LIGHTING  
PRESENTS

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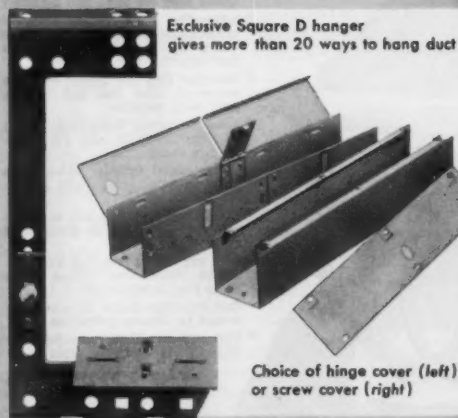
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—D-H5 Color Corrected  
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—F-H1 Color Corrected  
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# ELECTRICAL CONSTRUCTION AND MAINTENANCE

with which is consolidated Electrical Contracting, The  
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Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

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ELECTRICAL CONSTRUCTION and MAINTENANCE

OCTOBER 1959

Published monthly with an additional issue in September by McGraw-Hill Publishing Company, Inc. James H. McGraw (1860-1948), Founder, Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 36, N. Y. See panel below for directions regarding subscriptions or change of address. Publication Office, 99-125 North Broadway, Albany 1, N. Y. Officers of the McGraw-Hill Publishing Co., Inc.: Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President; L. Keith Goodrich, Vice-President and Treasurer; John J. Cooke, Secretary; Officers of the Publications Division: Nelson L. Bond, President; Shelton Fisher, Senior Vice-President; John R. Callahan, Vice-President and Editorial Director; Joseph H. Allen, Vice-

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 Subscriptions are solicited only from persons engaged in electrical construction, maintenance or consulting services. Position and company connection must be indicated on subscription orders.  
 United States subscription rate for individuals in the field of the publication \$3.00 per year. This issue 75 cents. Electrical Products Guide \$2.50, free to subscribers, Canada, \$5.00 a year. All other countries, \$15.00 a year, payable in advance. Second class postage paid at Albany, N. Y. Printed in U. S. A. Title registered in U. S. Patent Office.  
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# Washington Report

OCTOBER • 1959

**Business remains good** in spite of the steel strike, although pressure is building up for the government intervention in the strike unless management and labor show some signs of reaching an early agreement. The question now is not only when will the strike be settled, but also how soon steel shortages will become a major problem and what the possible consequences may be in the future. Demands for steel, now building up rapidly, represent near-capacity production well into next year.

National economy statistics currently available reflect only a minor dent due to the strike to date. These include: Employment fell 350,000 between July and August, with decline in farm jobs accounting for the total drop; Unemployment dipped in both July and August; Retail sales in August totaled \$18.1 billion, up \$1.5 billion from August a year earlier; Industrial production in August was down four points from July, to 149 (FRB Index); Personal income in August was \$381.4 billion, down from a record \$384 billion in July; Living costs eased in August to 124.8% of the 1947-49 average, down 0.1% from July's record level.

**New construction expenditures hit a new high** in August, with a total of \$5.3 billion of work put in place, up \$100 million from July, and well ahead of the \$4.7 billion total for August, 1958. Private expenditures were \$3,592 million, while public spending totaled \$1,692 million.

Housing starts in August were up 5,000 from the same month of 1958, to 129,000. This was also an increase of 3,000 starts from the July total.

A new housing bill was passed by Congress, and signed into law by President Eisenhower, which will 1) increase FHA insuring authority by \$8 billion, to a total of \$37 billion; 2) liberalize down payments on FHA-insured mortgages; 3) provide \$650 million in Federal grants for urban renewal (slum clearance) over two years. FHA has also increased the interest rate on home mortgages it insures to 5¾% from the previous rate of 5¼%.

**Capital outlays for new plant and equipment will increase** to \$33.3 billion this year, according to estimate following a survey recently completed by Dept. of Commerce and the Securities and Exchange Commission. This compares with a total of \$30.5 billion spent for this purpose during 1958. Government economists believe this upsurge will maintain well into 1960.

**A boost in Federal tax on gasoline** goes into effect on October first. This boost totals one cent per gallon, and is the result of a bill passed by Congress and signed into law by President Eisenhower last month. This tax is designed to help finance continued construction of the interstate highway system. It will run for a period of 21 months, when the total tax will drop to 3 cents which it was before the new law was passed. Bureau of Public Roads will allocate \$1.8 billion in fiscal 1961 Federal aid to the individual states, most likely apportioned on a quarterly basis, geared to match the inflow of money into the highway trust fund.

**Electricity output continues its climb** and maintains an average increase of about 8% to 10% ahead of year-earlier production. Total output in the third week of August topped 14 billion kwhr for the first time, and a week later totaled 14.1 billion kwhr. Contributing largely to this record performance was the increasing consumption of electricity for air conditioning during a hot weather spell.

"light  
ideas"

# ..from virden

to add plus profits  
to your fixture sales

## For Traditional Homes



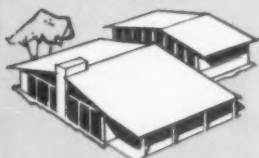
**V-1476** One of six gorgeously styled Colonial chandeliers. Handcut crystal and gleaming brass to add a brilliant touch to any room.

**V-6051** Authentic Early American in a pulldown. Polished brass with white shade. Opal chimney has star decorations.



**V-1499** Quiet dignity, warm hospitality is exemplified in this traditional design. In 6, 4, 3, and 2-light models, each hand-fashioned from solid brass.

## For Contemporary Homes



**V-1630** Modern blending of white imported plastic and polished brass, an exciting accent wherever it is used.

**V-1193** An unusually versatile 3-light cluster... use it in living rooms, dining areas, family rooms, anywhere you need a smart modern accent.



**V-6200** Perforated downlight with crystal lens. Polished brass. Excellent accent light.

**V-4465** Gleaming brass and satin white, in a modern blending.



**V-7940** Give your patios, porches, entranceways extra sales appeal with this outdoor wall lantern.

## For Transitional Homes

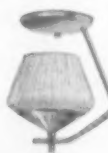


**V-1791** The lovely charm of polished copper and black in the popular pulldown style.



**V-1860** A touch of brilliance in an exciting 6-light chandelier. Use it with matching ceiling and wall lamps for a wonderful effect.

**V-6840** Add a touch of glamour with this bathroom fixture. Use it singly or in pairs.



**V-5880** Lift your halls and entryways out of the ordinary with this graceful design. Has matching wall unit and 5-light chandelier.



**V-3920** Give your bedroom the look of richness. Imported glass has crystal beads, polished brass trim.



Your Virden distributor has the complete line of Virden "light idea" fixtures on display now.



# virden

## LIGHTING



A Division of the John C. Virden Company  
Cleveland 3, Ohio  
Member American Home Lighting Institute  
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# Sidelights

## Cooper Named Fellow of IES

Berlon C. Cooper, associate editor of *Electrical Construction and Maintenance*, was named a Fellow of the Illuminating Engineering Society at a ceremony during the national technical conference of the Society in San Francisco last month. President George J. Taylor cited Mr. Cooper for "outstanding reporting of technical progress in lighting." Mr. Cooper is a graduate in electrical engineering of the University of North Carolina. His experience has included the design of lighting systems for Federal buildings. During World War II, he was Chief of the Lighting and Fixtures division of the War Production Board. He later joined the staff of this publication, and his published reports of the progress of practical illumination technology have won him international renown.



## Electric Heat in Hartford City

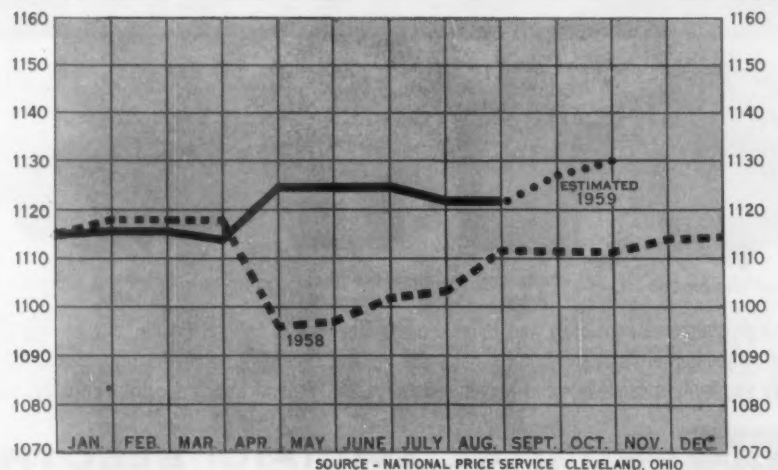
Progress in electric space heating application is often thought of in terms of big city promotion campaigns like current developments in Chicago or St. Louis. But electric heat is for everybody and testimony comes from Hartford City, Ind., that there are waiting opportunities in smaller communities as well. The Hartford City utility began promoting electric heat only five years ago, and current installations are running three times the national average. Influenced by surrounding heavily-electrified farms, the people in the area are naturally interested in modern electrical living. Well designed installations skillfully installed by Hartford City electrical contractors have built highly favorable customer acceptance. Bill Martens rounds up the results in "Electric Heat Clicks in Hartford City" beginning on page 138.

## Billing Extras

Charging or crediting change orders or "extras" presents a chronic problem for electrical contractors. They must produce a fair return for the contractor and still satisfy the customer and maintain his good will. How should change orders for additional work be billed? How should omissions be credited? What is fair practice for the contractor and the customer? Ray Ashley, consulting engineer and authority on electrical contracting practice, gives effective and practical answers in his article, "Billing Contract Additions and Changes" beginning on page 134.

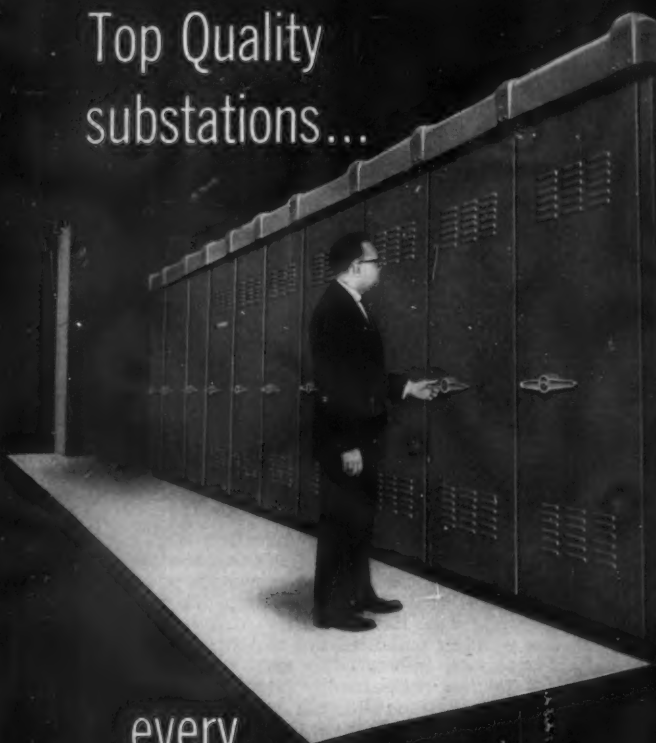
## ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



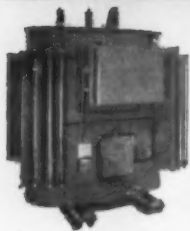
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substations...



15 kv outdoor primary unit  
substation styled by Raymond Loewy

every  
major component  
manufactured by  
Federal Pacific



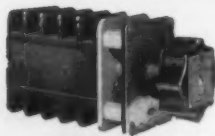
Power Transformers



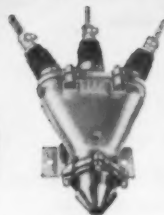
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Relays



Indicating  
Instruments



Instrument  
Switches



Potheads



High Voltage  
Air Breakers

For single-source responsibility and reliable operation, look to Federal Pacific, one of only three companies to manufacture every major component of its primary unit substations. Federal Pacific's unit engineering, coordinated assembly, integrated quality control assure you built-in reliability and longer substation life. Federal Pacific Electric Company, General Offices: Newark 1, New Jersey.



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Another Engineering Achievement

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introduces  
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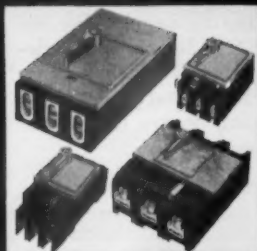
ROTARY HANDLE  
CIRCUIT BREAKER!



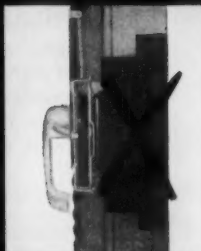
it's new...

it's safe...

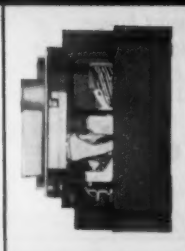
it locks!



Complete line rated 15 through 800 amperes in four breaker frame sizes: EF 100a, F 225a, J 400a and M 800a.



Rotary handle eliminates the trouble zone of external handle mechanisms, always indicates true position of breaker mechanism, provides greater dependability and safety.



Unique locking ring accommodates 3 padlocks. Can also be locked with a key.

FIRST REAL CHANGE IN AB BREAKERS SINCE 1927...Obsoletes flip-handle circuit breakers. Federal Pacific's new integral handle eliminates excess, trouble-making linkage...Handle position always indicates breaker position...built big and rugged for industrial use in switchboards, control centers, control panels, panelboards, and individual enclosures—you can see this man-sized handle from a distance...Uses easy to operate rotary action...Unique locking feature for safety—Get the details of this stride forward in AB breaker design now. Write for Bulletin #1425, Federal Pacific Electric Company, General Offices: Department 328, Newark 1, New Jersey.



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## "Telephone planning is just the kind of built-in convenience home buyers want"

—SAYS CHARLES V. SIMMS,  
CUSTOM BUILDER OF DAYTON, OHIO

"You can't ignore what people want," says builder Charles Simms, of Dayton. "People *do* want telephone-planned homes today.

"Five years ago, pre-wiring a home for telephone service was a special feature few people expected. Today, they ask about it, even insist on it. They appreciate the convenience of having built-in telephone outlets throughout their home—and the common sense of having wires concealed inside the walls, with only neat outlet plates visible."

Mr. Simms builds custom homes priced from \$18,000 to \$40,000 with as many as *nine* telephone outlets in them. They are advertised as "Communication Conditioned" homes.

"A builder has to merchandise his product," says Mr. Simms, "and telephone planning is good merchandising. The public wants this feature—and the telephone company makes it practical to offer it, costwise."

Your local Telephone Business Office will gladly help you with telephone planning for your homes. For details on home telephone installations, see Sweet's Light Construction File, 8i/Be. For commercial installations, Sweet's Architectural File, 32a/Be.

**BELL TELEPHONE SYSTEM**



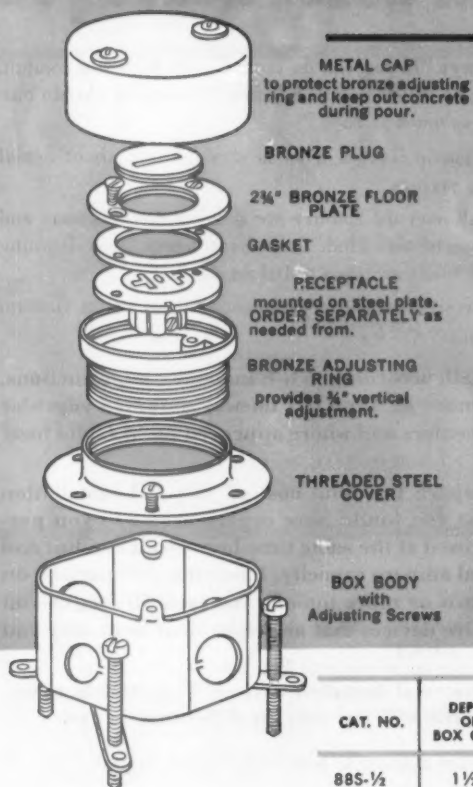
The builder and telephone representative Mary Ellen Sears stand before "The Brookfield"—chosen Dayton's "Home of the Year"—in Mr. Simms' Spring Valley Acres development.





fastest installation...  
lowest possible cost

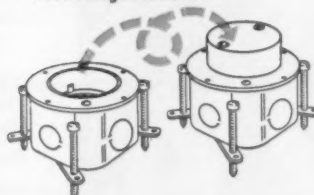
# series '88' FLOOR BOXES



The simplified assembly of "88" Series Floor Boxes assures fast installation, true leveling and quick access to wiring—at low cost.

## "88" Series Floor Box Features

- Fully adjustable bronze floor ring— $\frac{3}{4}$ " vertical adjustment
- Floor box accepts variety of receptacles—plus high and low potential standpipes and service fittings
- Wide hand hole for access to wiring—plenty of finger room
- Durable—brightly finished—bronze floor plates
- 4" octagon outlet box— $1\frac{1}{2}$ " or  $2\frac{1}{8}$ " deep. Electro-galvanized
- Rigid screw-leg brackets with exterior screws for rough level adjustment



"88" Series boxes are packaged with metal protective cap in place. Simply reverse the assembled top and install box

## SPECIFICATIONS AND ORDERING INFORMATION

CAT. NO.	DEPTH OF BOX ONLY	K. O.'s IN BOX		FLOOR PLUG SIZE	OVERALL HEIGHT Box & Adjusting Ring		APPROX. WGT. EACH LBS.	STD. PKG. QUAN.
		SIDES	BOTTOM		MAX.	MIN.		
88S- $\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{3}{4}$	$\frac{1}{2}$ Pipe	$3\frac{3}{8}$	$2\frac{1}{8}$	$2\frac{1}{2}$	10
88S- $\frac{3}{4}$	$1\frac{1}{2}$			$\frac{3}{4}$ Pipe	$3\frac{3}{8}$	$2\frac{1}{8}$		10
88S-2	$1\frac{1}{2}$			2 Dio.	$3\frac{3}{8}$	$2\frac{1}{8}$		10
88D- $\frac{1}{2}$	$2\frac{1}{4}$	$2\frac{1}{4}$	$3\frac{1}{2}$	$\frac{1}{2}$ Pipe	$3\frac{1}{8}$	$3\frac{3}{8}$	$2\frac{3}{4}$	10
88D- $\frac{3}{4}$	$2\frac{1}{4}$			$\frac{3}{4}$ Pipe	$3\frac{1}{8}$	$3\frac{3}{8}$		10
88D-2	$2\frac{1}{4}$			2 Dio.	$3\frac{1}{8}$	$3\frac{3}{8}$		10
88DA- $\frac{1}{2}$	$2\frac{1}{4}$	4-1		$\frac{1}{2}$ Pipe	$3\frac{1}{8}$	$3\frac{3}{8}$		10
88DA- $\frac{3}{4}$	$2\frac{1}{4}$			$\frac{3}{4}$ Pipe	$3\frac{1}{8}$	$3\frac{3}{8}$		10
88DA-2	$2\frac{1}{4}$			2 Dio.	$3\frac{1}{8}$	$3\frac{3}{8}$		10

SOLD ONLY THROUGH LEADING ELECTRICAL DISTRIBUTORS

**STEEL CITY ELECTRIC COMPANY** / PITTSBURGH 33, PA.

# CONTRACTORS FIND: New G-E Plug-in Busway costs



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*H. P. Foley*  
H. P. Foley Co.  
Wilmington, Del.



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Alvin J. Hiltner*  
Eastern Electrical  
Construction Inc.  
West Collingswood  
Heights, N. J.



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Collins Electrical Construction Co.*  
Collins Electrical  
Construction Co.  
St. Paul 7, Minn.



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Hoffman & Son Inc.*  
Hoffman & Son Inc.  
Long Beach, Calif.



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Libecap Electric Co., Inc.*  
Libecap Electric Co.,  
Inc.  
Dallas 10, Texas



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Bliss & Sage Electrical*  
Bliss & Sage Electrical  
Malden, Mass.



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*J. L. Krauser Co.*  
J. L. Krauser Co.  
Portland 14, Oregon

## GENERAL ELECTRIC SAYS: Try it - if it doesn't save you



Type DH Busway is rated 100 amperes, 3-wire, single or 3-phase, or 4-wire, 3-phase 600 volts maximum. It serves either as a feeder or plug-in system and may be used indoors wherever exposed wire and conduit could otherwise be applied.

♦Offer limited to installations made between September 1, 1959 and December 31, 1959. Claims must be received by your distributor on or before January 4, 1960. Offer does not apply to installations made in New York, New York, Newark, New Jersey or the State of California.

Contractors say: "If you can do the job with wire and conduit, we find you can do it now with G.E.'s new 100-ampere plug-in busway—and save as much as 25%."

This is not poetic license. This is straight talk about actual dollar-and-cents savings.

Contractors all over the country are echoing this statement and reporting savings of this kind. Some contractors, after learning the facts, have actually switched to DH on the job.

The facts are simple, and to demonstrate them to you, General Electric makes this offer ♦:

(1) Install, according to G-E installation instructions, 50 feet or more of Type DH busway mounted edgewise on 10-foot centers and where approved by NEC and local codes.

(2) Compare the total cost of this DH installation with the cost you would have experienced had you purchased and used at the same time heavy-wall conduit and wire of equal ampere capacity. Base your comparison on the use of two or more tap-offs for each 50 feet of run and protective devices that are equivalent in quality and function.

(3) If the total installed cost of Type DH is more, General Electric will pay you the difference in cash.†

Try DH. You have nothing to lose — and much to gain.

†Example: Suppose DH costs you \$250.00 installed and that you determine an equivalent run of wire and conduit would have cost you \$230.00. The difference is \$20, which General Electric would pay you in cash.

For further details, see your G-E representative or distributor. Ask for Bulletin GEA-6172 — or contact Distribution Assemblies Department, General Electric Company, Plainville, Conn.

# less installed than wire and conduit!



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*West Electrical Construction Co.*  
Tulsa, Oklahoma



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Cooper Electrical Construction Co.*  
Greensboro, N. C.



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Peifer Electric Co.*  
Trenton, New Jersey



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Brooker Electric Co., Inc.*  
Detroit 7, Michigan



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Fisk Electric Co.*  
Houston, Texas



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

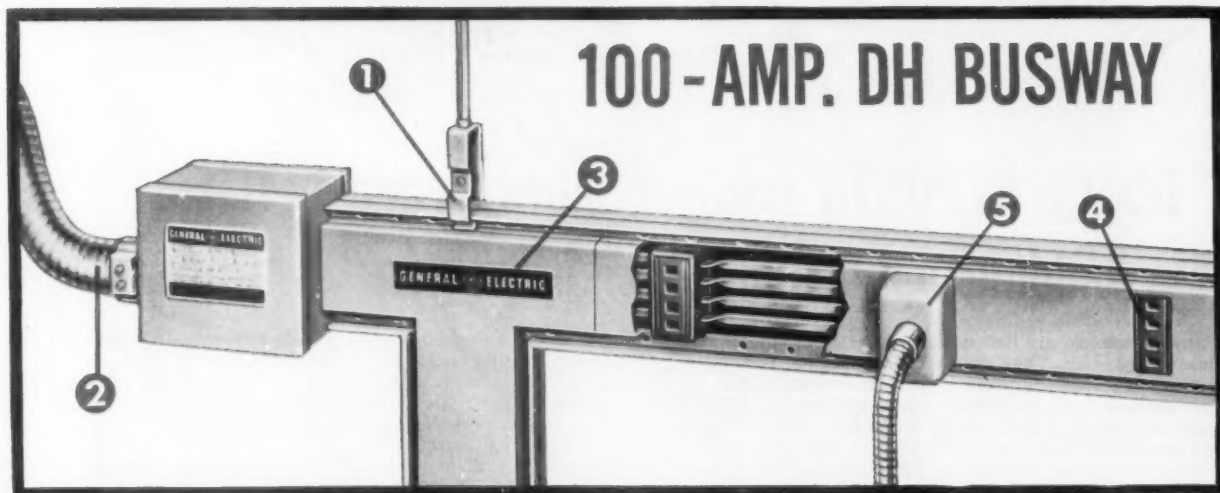
*Loomis Electric Co.*  
Akron, Ohio



"New G-E plug-in busway costs less installed than wire and conduit of equal ampere rating."

*Charles Electric Co.*  
Hartford 6, Conn.

## money, G.E. will pay the difference in cash!



### Easy to install because:

- ① snap-on hangers save time.
- ② flexible fittings and adjustable length eliminate need for exact measurements.
- mechanical and electrical joint connections are made simply by tightening six screws.
- light weight (27 pounds per 10-foot length) and small size make for easy handling.
- approved for mounting edgewise on 10-foot intervals instead of usual five.

### Flexible because:

- ③ standard fittings—both rigid and flexible—allow run to be tailored quickly to virtually any building contour.
- each 10-foot length has 18 outlets, nine on each side.
- lengths can be removed from run without disturbing adjacent lengths.

- same current rating in any position.

- 1-, 2-, 3-, 5- and 10-foot lengths.

### Safe because:

- ④ outlets are virtually "dead front" even after covers are removed.
- ⑤ plugs are totally enclosed and polarized.
- 15,000-ampere short circuit rating standard (100,000 when protected by CLF fuses).
- entire system listed by Underwriters' Laboratories, Inc.

### Salvable because:

- entire run can be taken down, moved to new locations and re-installed with complete re-use.

### Easy to order because:

- DH is stocked nationwide by G-E distributors.

# GENERAL ELECTRIC

*"I hate being tied down  
in my own back yard"*



## **DODGE REPORTS uncover more...and better... bidding opportunities right in your own area**

Many contractors are tied down by unreliable and incomplete information. They depend on gossip and rumors in locating new building projects, and on invitations to bid. This can be a costly, ineffective way to get business. *Unnecessary*, too. Because daily *Dodge Reports* give you the facts you need on bidding opportunities, when you need them.

*You know what's coming up for bidding when you use Dodge Reports.* You learn of many opportunities you might otherwise miss. You don't have to depend on gossip, rumors, or invitations to bid.

*You concentrate on jobs you know will be profitable.* *Dodge Reports'* reliable advance information helps you spot the new building projects that will do you the most good.

*You learn who the general contract bidders are...who's bidding on major trades out for separate bids...and which ones get the contracts.*

*Dodge Reports* are individual project reports. They're mailed to you daily. You get *Reports* only on the types of building you're interested in - in the area where you do business. They tell who's going to build what and where... whom to see... when bids are wanted... and other pertinent facts.

If you do business anywhere in the 37 Eastern states, let us show you how *Dodge Reports* can help you uncover more - and better - bidding opportunities right in your own area.

### **WRITE FOR FREE BOOK**

F. W. Dodge Corporation, Construction News Division,  
119 West 40th Street, New York 18, N. Y., Dept. ECM109

Send me the book "Dodge Reports—How to Use Them Effectively" and let me see some typical Dodge Reports for my area. I am interested in the general markets checked below.

- ☐ House Construction      ☐ General Building  
☐ Engineering Projects (Heavy Construction)

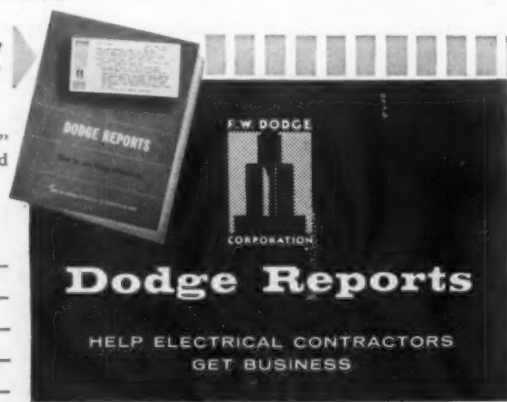
Area \_\_\_\_\_

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

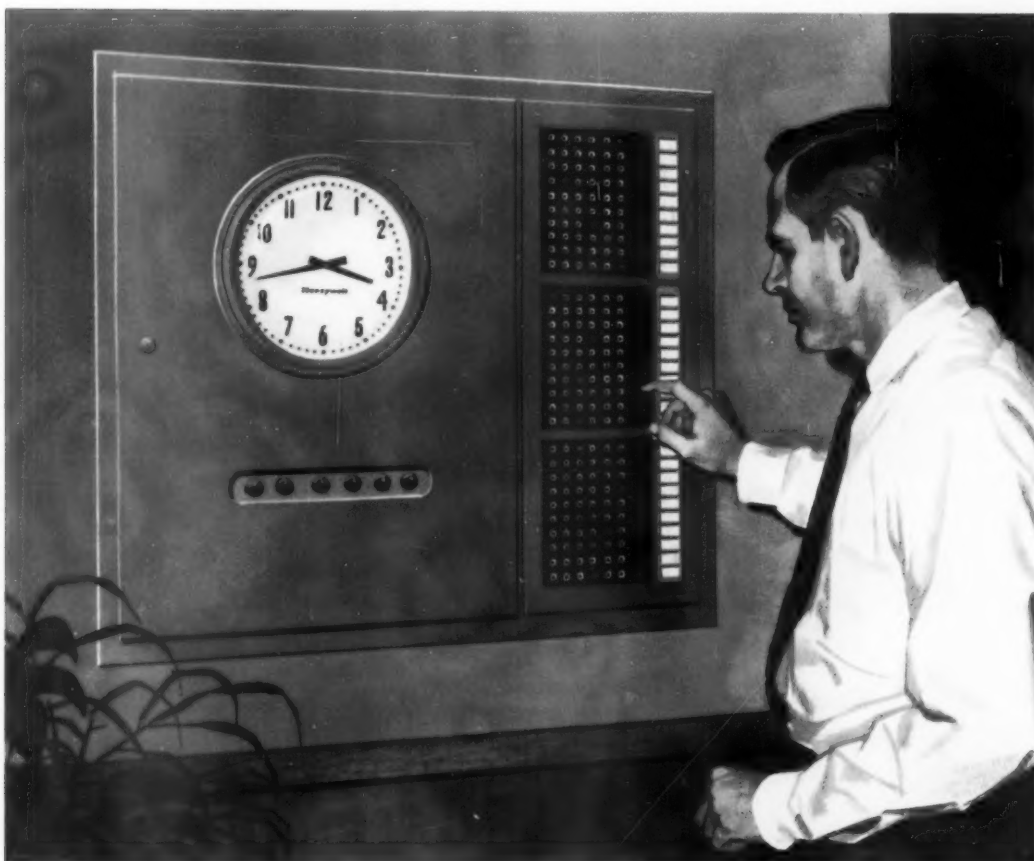
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_





# Three Important Signal Systems from Honeywell!

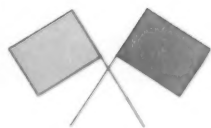
- ◆◆ *Clockmaster Time and Programming Systems*
- ◆◆ *Fire Detection and Alarm Systems*
- ◆◆ *Surveillance Alarm Systems*



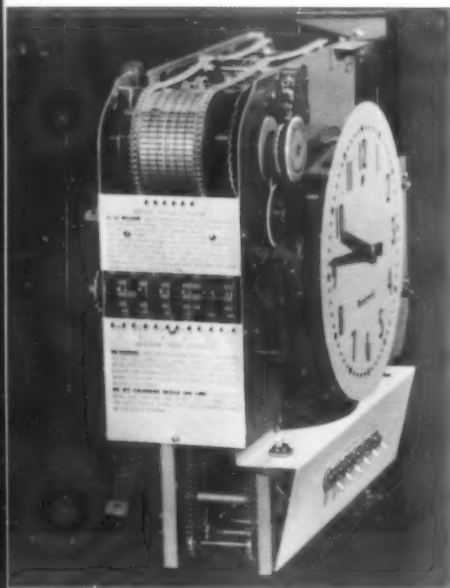
**Honeywell Clockmaster\* Systems** are available in either synchronous wired or minute impulse types. In both systems Honeywell furnishes flush or surface mounted clocks in 9", 12", 15" or 18" dials. Both systems are self-correcting every hour with independent correction for each clock in the system.

A switch on the master clock permits substituting

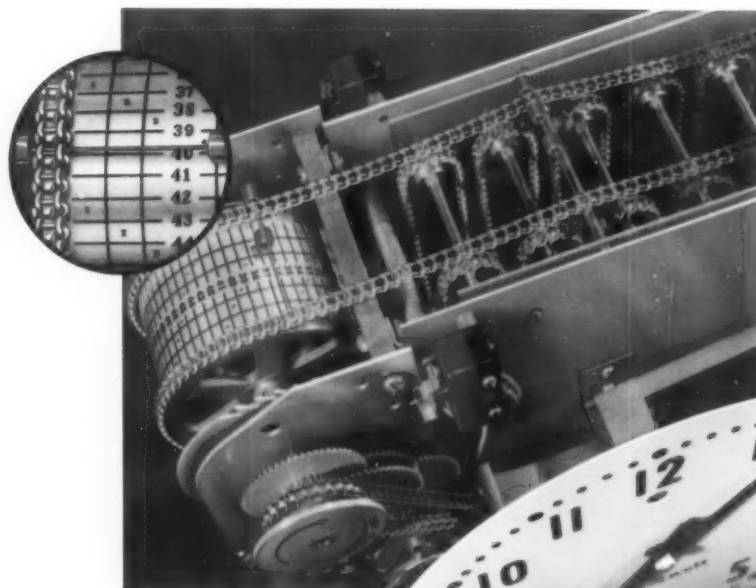
manual switching or silence instead of automatic programming. Quick-change calendar device permits silencing any circuit during any 12 hour period of the week. A spring power unit is available for emergency use during power failure. Honeywell's system is especially wanted in schools because it offers the easiest-to-set programming on the market. ● ● ● ● ●



## Here's why Honeywell Clockmaster Programming is the easiest to set!



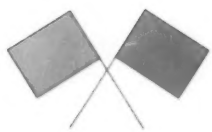
**Easy-to-set signal drum.** Honeywell's Clockmaster eliminates fuss and bother from program setting. Just turn signal drum to time, slip steel pin through chain links and slide on one of the reusable plastic rollers. To change signal, roller can be shifted without affecting any other part of the program. Special round pin-in-square-hole construction holds each signal roller firmly in place.



**Easy-to-read numbers: Link chain ruggedness.** Numbers on the signal drum are large, easy to read, and never confuse the program setter. Two precision link chains, color-coded for day-night identification, guide the entire program whether it includes three circuits or six. Chains are rated at twenty times load for insurance against breakage. Chains run continuously over idler gears. No piling at bottom of cabinet.



**Dial-it clockwise program unit.** Master time and master signal units are positively linked together. No chance for them to get out of step. When a program is set, the time setting knob is turned. As the clock hands reach the desired time, the program drum turns, too. In the same way, if power is interrupted, programmer runs on spring power with the master clock. When power is restored, signals again are right on schedule.



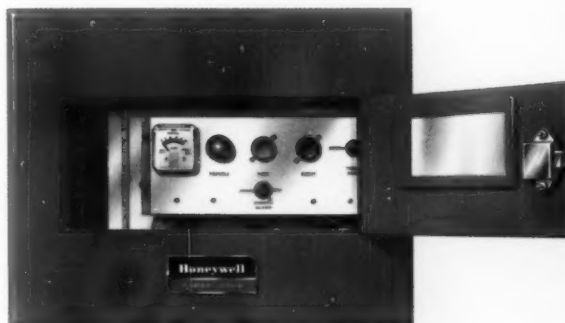
## Honeywell's complete fire detection and alarm equipment offers greater flexibility... one reliable source!



Detector



Manual Station



W247 Panel

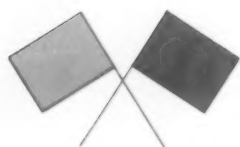
Now depend on one reliable source, Honeywell, for a fire detection and alarm system to meet the requirements of any building. Honeywell furnishes manual, automatic and sprinkler-water-flow systems, singly or in combina-

tion, furnishes all components, too—panels, detectors, manual stations, switches, bells, horns and buzzers. They're all built to rigid quality standards—all backed by Honeywell and famous Honeywell service.



Numbered lights identify a fire's location with Honeywell's W237 panel. This enables a supervisor to direct immediate fire fighting measures. Other features of this system include electrical supervision of the detecting circuit. Trouble signal and light indicate any wiring break. Signal may be silenced until repairs are made but trouble light stays on. Alarm will sound even if there is a break in the detecting circuit. And entire system may be tied in to local fire and police headquarters.

Honeywell's W247 panel uses a 2-wire circuit designed so that both detector and alarm circuits are electrically supervised. Any wiring break is immediately indicated by a trouble signal. If system is connected to a municipal alarm, a switch disconnects it during fire drills. Features large bell capacity—up to 5 bell circuits operating a total of up to 50 bells.



## Honeywell Surveillance Alarm Systems help prevent breakdowns of critical equipment with economical one-man supervision

Wherever important operating equipment is scattered throughout a building or group of buildings it requires frequent checking. However, it needs actual maintenance attention only if there is trouble. Honeywell Surveillance alarm system replaces intermittent personal checking with continuous automatic supervision of boilers, compressors, tank levels, fans, motors and other critical equipment.

Red lights identify and locate trouble. Panel supervisor at central location can communicate with maintenance men who will correct trouble before it becomes extensive enough to cause a breakdown.

Unique circuitry permits a single pair of wires to carry warning signals from several pieces of equipment in the same area and to provide emergency communications with the area.

All connecting wires are electrically supervised so that any wiring break sounds a trouble signal. Thus the system supervises itself as well as the equipment it guards.



### EVERY SYSTEM BACKED BY HONEYWELL'S UNIQUE MAINTENANCE AGREEMENT

With every one of these Honeywell Signal Systems, Honeywell offers a unique maintenance agreement to the owner. For a low annual cost, Honeywell provides periodic maintenance and inspection by factory-trained experts.

Parts and repairs, if ever needed, are provided at no additional cost. Emergency calls answered without charge.

And it's backed by 112 Honeywell sales-service offices throughout the country which bring service personnel within reach of any installation.

For more information about this Honeywell Maintenance Agreement or about any of the systems described here, call your local Honeywell office. Or write Honeywell, Dept. ES, Mpls. 8, Minn.

# Honeywell

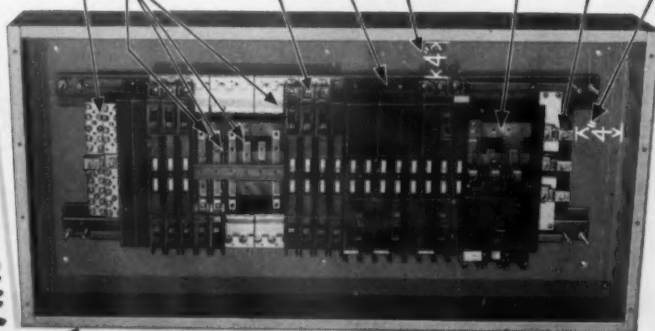


*First in Control*



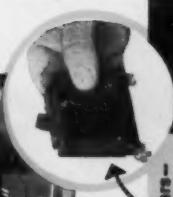
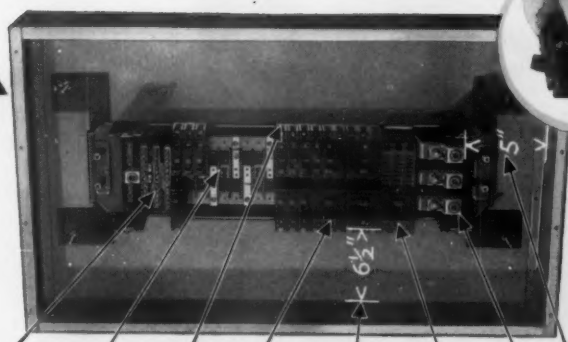
# YOU ARE LOOKING AT THE GREATEST IMPROVEMENT IN PANELBOARDS IN MORE THAN 20 YEARS!

*This is what you've been using*



- Blinder-head Screw Neutral Taps .....
- Large Number of Parts Required for Additions and Replacements .....
- Screw Terminals on Branch Circuit Breakers .....
- Unable to Mount One and Two Pole Breakers Opposite Three Poles .....
- Crammed Side Gutters .....
- Special Installation Required for 100 Amp Frame Breakers .....
- Lugs for Copper Conductors Only .....
- Minimum End Gutters .....
- Box-type Neutral Lugs .....
- Simplified Breaker Connection — One Screw .....
- All Joints Plated .....
- Bussing Like Wiring Diagram You Can See What Phase You're Connected To .....
- Box Lugs on All Circuit Breakers .....
- One and Two Pole Breaker May Mount Opposite Three Poles .....
- 20"-wide Box Provides Roomy Side Gutters and Plenty of Room for Conduit in End Wall .....
- 100 Amp Frame Breaker May Replace Two 50 Amp Frame Breakers .....
- Lugs for Either Copper or Aluminum UL Approved .....
- Full 5" End Gutters .....

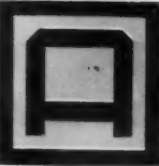
*This is what Square D's  
New NQOB\* Gives You*



\*The Q.O. in NQOB means QWIK-OPEN breakers — they trip instantly at 10 times full load rating. The B in NQOB means BOLTED CONNECTIONS. If you prefer plug-in construction, specify NQO

Write for the complete story Square D Company, 6060 Rivard Street, Detroit 11, Michigan

**SQUARE D COMPANY**





2515 \*



3401 \*



3213-I \*

## **CIRCLE F WIRING DEVICES**



136 \*



2035 \*



585 \*



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2517 2516 \*



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2632 \*

*whatever your  
wiring device  
needs . . .*

CIRCLE F devices give you everything you want—and you save money, too! High quality, low cost Circle F wiring devices provide fast, easy installation, trouble-free service and eliminate call-backs. Precision engineering and quality-controlled production plus rugged construction guarantee customer satisfaction. Circle F devices are available at Electrical Wholesalers everywhere for quick pick-up or delivery.



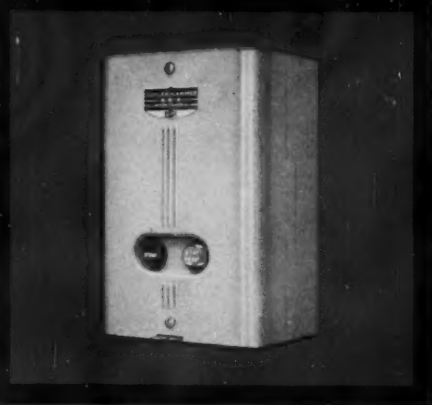
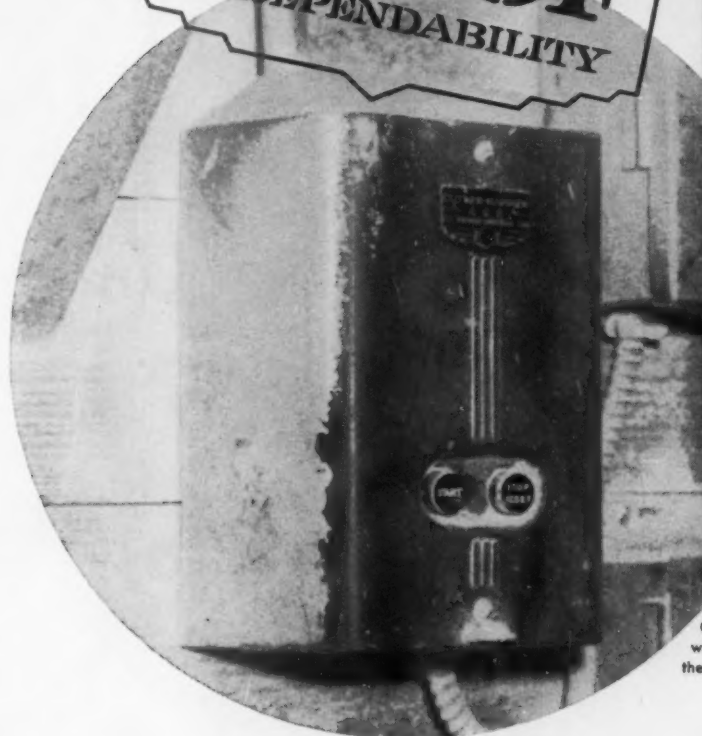
\*Only one of a complete line.  
For additional information,  
write for catalog.



# **CIRCLE F MFG. CO.**

TRENTON 4, NEW JERSEY • For your wire requirements: Eastern Insulated Wire Corp., Box 591, Trenton, N. J.

**PROOF  
OF DEPENDABILITY**



Only Cutler-Hammer Three-Star Motor Control with vertical dust-safe contacts could withstand the ravages of the flour-like kaolin dust.

## Large Southern kaolin processing plant cuts maintenance costs with Cutler-Hammer Control

By the very nature of the product, kaolin processing is an extremely dusty operation. Because of this the electrician at a large Southern kaolin plant found it necessary to replace the dust-fouled contacts in the motor starters every 30 to 60 days. Several makes of motor control were tried, but the results were always the same . . . dust laden contacts were rapidly requiring frequent attention.

Thirteen months ago a Cutler-Hammer Three-Star Magnetic Starter with vertical dust-safe contacts was installed, and the electrician reports perfect operation with-

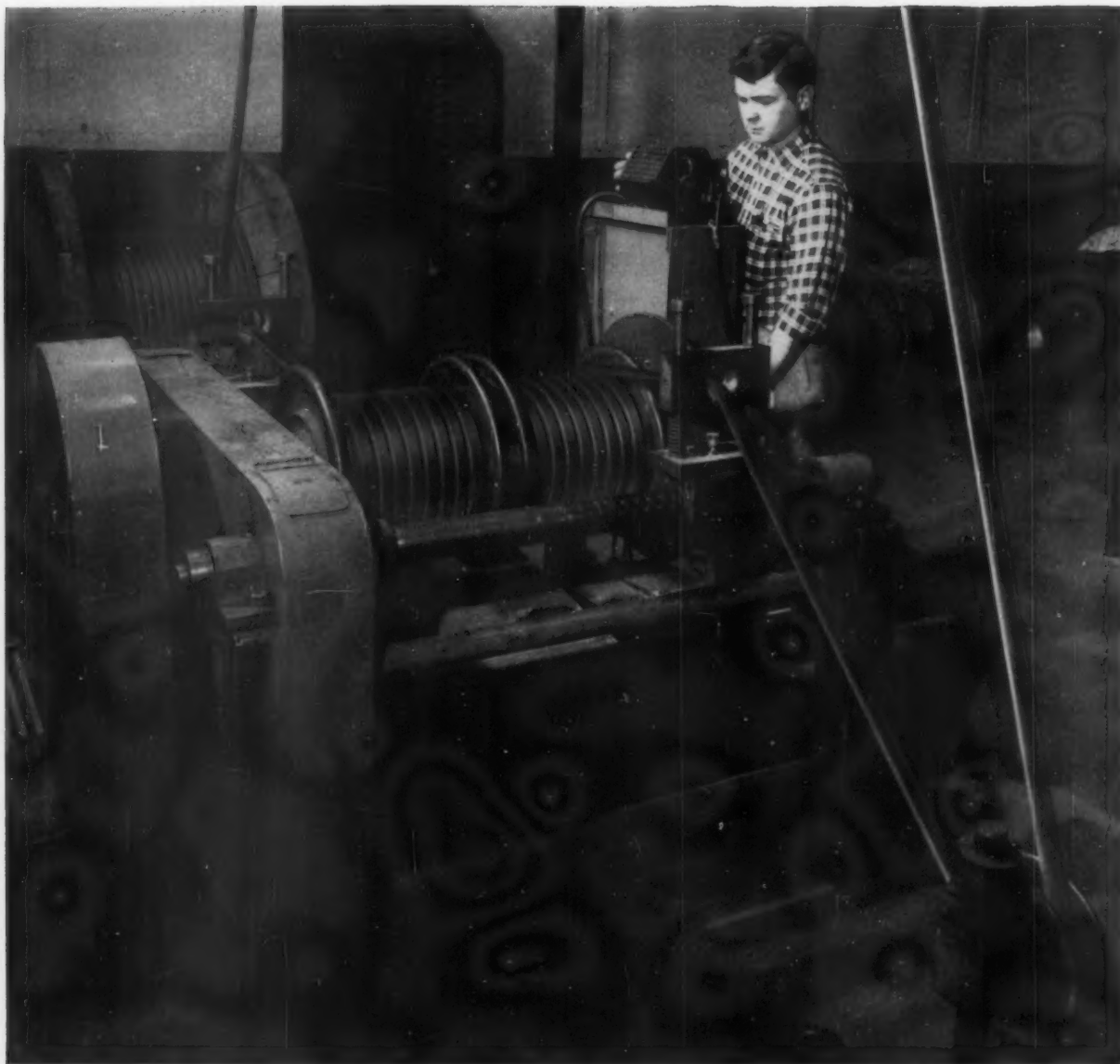
out a single contact replacement . . . no time lost for repairs.

This is positive proof of dependability . . . proof that Cutler-Hammer Three-Star Motor Control works better, lasts longer than any other on the market today. Why take chances with costly production interruptions? Order dependable Cutler-Hammer Three-Star Motor Control from your nearby Authorized Cutler-Hammer Distributor today. For complete ordering information, write for the Cutler-Hammer Merchandiser, EA-100-U241. Cutler-Hammer Inc., Milwaukee 1, Wisconsin.

# CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wis. • Division: Airborne Instruments Laboratory. • Subsidiary: Cutler-Hammer International, C. A.

Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.; Intercontinental Electronics Corporation,



**Accelerated testing of cable.** This machine, designed by AS&W engineers, is testing mining machine cable to determine its resistance to reeling and pay off under tension, abrasion, flexing under tension, kinking under tension. Just one of the ways to determine the best insulating and jacketing compounds.

From portable tools to the largest power shovels, Amerclad Cables offer safe dependable service.

It's how you mix ingredients in just the right proportions that makes a big difference in cable performance.



## Tiger Brand Electrical Wire & Cable

A standard cable for every special job

- Asbestos Wire and Cable
- Mold-Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable



# What's the difference in electrical cable?

## In **USS** Tiger Brand Amerclad it's better engineering and quality construction

*Engineered for the job.* USS Tiger Brand Amerclad Cables are used in such a variety of applications that "engineering for the job" becomes extremely important. Special constructions are designed for electric shovels, dredges, mining machines, welders and portable tools. Cable life depends on how well the engineers have anticipated all the destructive forces that a cable encounters in service.

*Quality construction.* USS Amerclad's highly flexible construction—rubber insulated conductors and Amerprene jacket—is carefully designed to give you superior electrical performance and mechanical reliability. Dynamically balanced rope lay conductors, as opposed to loosely bunched groups of fine wires, give balanced performance and long, trouble-free service through elimination of unequal tension and elongation.

Each conductor is separately insulated with Amerite, a tough heat-resisting, special rubber compound that exceeds the requirements of ASTM, and other industry standards. A rugged abrasion resisting Amerprene jacket protects the cable from mechanical abuse.

Tiger Brand Amerclad Cables are as tough as they come. They soak up shock and vibration, withstand crushing impact, severe jerking and pulling for unbelievably long periods. Used outdoors for mining, quarrying and excavating machines, Amerclad resists the constant wear and abuse from contact with rocky

ground. And installed on lighter indoor equipment—electric welders, shop tools and motor leads—Amerclad gives top performance even when it's dragged over rough floors, through oil, grease or water.

Amerclad's greater durability will pay for itself many times in unflinching service, and ability to handle rated loads. It's the toughest electrical cord and cable money can buy.

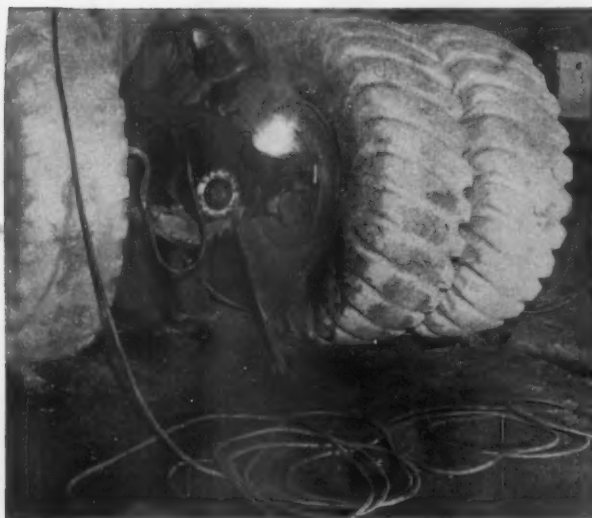
*Send for catalog.* The Tiger Brand Amerclad Cable story is told completely in our new book we've reserved for you. We'll send the book without cost or obligation. American Steel & Wire, Dept. 9289, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

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Division of  
United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors  
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors  
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## Neoprene jacketing on the job...at $-65^{\circ}\text{F}$ .

*Specially compounded neoprene jackets can withstand mandrel wrap tests down to  $-65^{\circ}\text{F}$ .—often required in military specifications. Even at 65 below, neoprene jackets remain flexible for portable uses. More important is neoprene's excellent retention of low-temperature properties after years of aging. This holds true for all of neoprene's combination of properties . . . properties that insure long-term reliability. For information, write E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. EC-10, Wilmington 98, Del.*

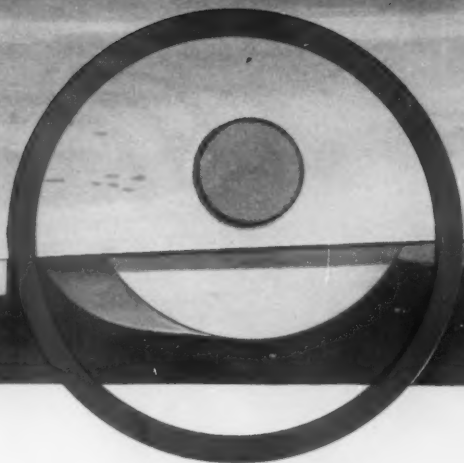


**SYNTHETIC**

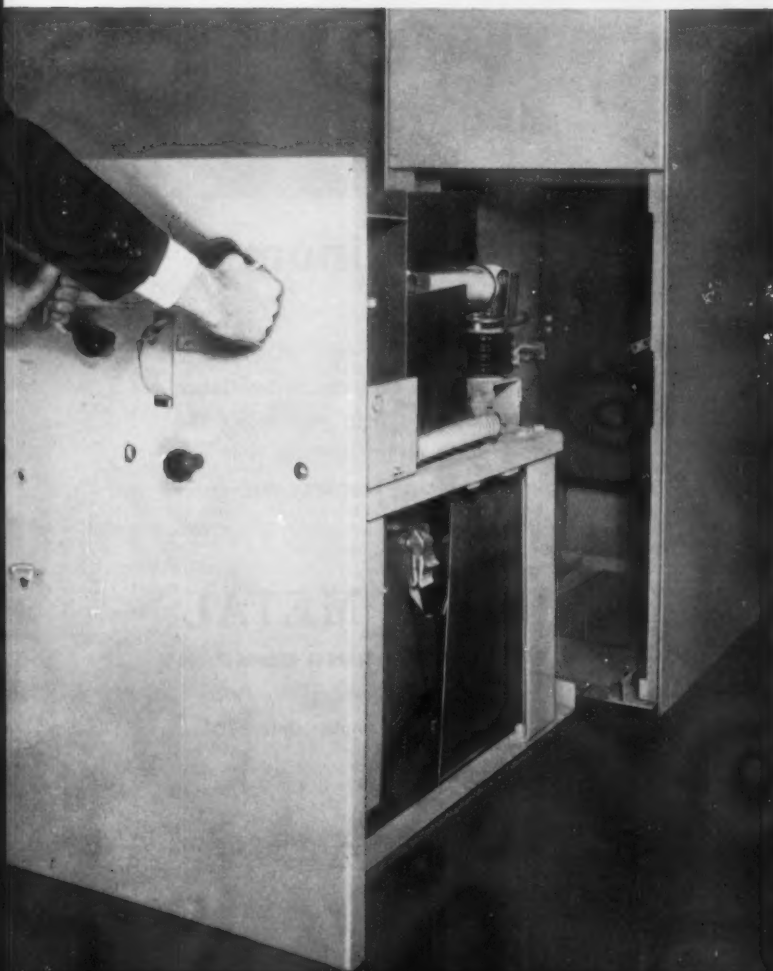
**RUBBER**

**NEOPRENE  
HYPALON®  
VITON®  
ADIPRENE®**

**Better Things for Better Living . . . through Chemistry**



Simple maintenance, inspection with  
General Electric **ROLLOUT**  
Switch and Fuse Equipment



It's new—General Electric Rollout Switch and Fuse Equipment. It rolls out like a file cabinet drawer—allows simple, fast inspection and maintenance. Plus—improved protection, greater safety, and installation flexibility.

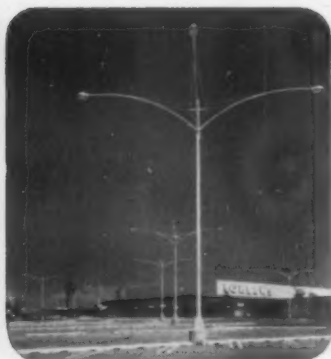
For more information on this new Rollout Switch and Fuse Equipment call your nearest General Electric Apparatus Sales Office or write for bulletin GEA-6623, General Electric Company, Schenectady, New York.

514-2

*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

NEW ROLLOUT SWITCH AND FUSE EQUIPMENT, in ratings from 2.4 kv to 13.8 kv, is applicable for both normal switching and fault current protection.



Oshawa Shopping Center,  
Oshawa, Ontario, Canada.



Tip Top Mart, Canton, Ohio.



Sears, Roebuck Store, Tampa, Florida.

## Area Lighting with **Monotube Poles** offers you unmatched design choice in steel or aluminum



Southgate Shopping Center, Cleveland, Ohio.



Garden State Plaza, Paramus, N. J.

Union Metal engineering assistance is available to help you select the most appropriate lighting pole design combining economy and good appearance.

### **THE UNION METAL** **MANUFACTURING COMPANY**

*Monotube Area Lighting Poles*

Canton 5, Ohio • Brampton, Ontario, Canada



# Naugatuck KRALASTIC

Rubber-Resin



## KRALASTIC conduit contributes to 43% savings

New York State Electric and Gas Corporation has learned how to install underground circuits for electric lighting faster, more economically, and with less disruption of landscaped property. A key to the operation is KRALASTIC.<sup>®</sup>

Used in place of conventional conduit, 20-foot lengths of KRALASTIC semi-rigid conduit are threaded over the cable, cut to length as needed, joined with a molded KRALASTIC slip fitting. All work is done above ground and the protected cable simply dropped into the trench. At driveways and similar obstacles, the conduit is snaked through a hole formed by a  $\frac{3}{8}$ " rod and cone.

N.Y.S.E. & G. found 1½" conduit gave a saving of 15¢ per foot installed. Material costs were reduced further when conduit size was reduced to 1¼" and standard bases were fed by locally made long-

radius bends. Additional savings resulted from the fact that conduit breakage during handling was eliminated, and KRALASTIC's light weight made it possible for a standard line truck to carry a full day's supply of conduit, eliminating the need for on-site storage and attendant problems.

Strength, light weight, and resistance to corrosive soils and chemicals are among the reasons why KRALASTIC has been steadily gaining popularity over both metals and other plastic materials not only for electrical conduit, but for municipal and home water service, well piping, salt water disposal, oil, gas, and chemical lines, radiant heating installations, piping applications by the hundreds.

Learn more of the many advantages KRALASTIC offers you. Contact your Naugatuck Representative or the address below today.



### United States Rubber

Naugatuck Chemical Division

DEPT. 1034K ELM STREET  
NAUGATUCK, CONNECTICUT

KRALASTIC RUBBER-RESINS • MARVINOL VINYL • VIBRIN POLYESTERS

Akron • Boston • Gastonia • Chicago • Los Angeles • Memphis • New York • Phila. • CANADA: Naugatuck Chemicals • Elmira, Ont. • Cable: Rubexport, N.Y.

# Edwards sets up new business for you

## IN INDUSTRIAL MODERNIZATION AND EXPANSION

**C**urrent plans for plant construction and modernization call for an annual expenditure of over 850 million dollars in electrical equipment. A significant part of this investment is in signaling equipment for control, communication and protection.

Right now, Edwards distributors are calling on industrial plants, surveying their needs for signaling equipment. And *Here's Where You Come In.* Edwards recommends the recognized electrical contractor as the installer of its products. You can team up with the distributor to present a quotation on an installed basis. (The Edwards Technical Representative is always available to help prepare quotations on the proper equipment). Write for the name of your local participating distributor and ask for a handy pocket-size book of products and systems for the industrial market. Edwards Company, Inc., Norwalk, Conn. In Canada: Edwards of Canada, Ltd, Owen Sound, Ontario.



Fire Alarm Systems



Paging Systems



Annunciator Systems



Clock and  
Program Systems

### EDWARDS INDUSTRIAL PRODUCTS

**Fire Alarm Systems**—to protect life and property by giving a warning on detection of fire. Manual and/or automatic detection.

**Clock and Program Systems**—to sound signals in plants or offices for lunch hours, changes in operations on assembly lines, closing hours or other time schedules. Centrally controlled clock system for accurate operation of clocks, time recorders, time stamps and program machines.

**Paging Systems**—for locating key personnel with both audible and visual signals. Silent paging also available permitting up to 3-person paging simultaneously.

**Intercommunication Telephone Systems**—low cost system without switchboard connecting key points within plant.

**Annunciator Systems**—to indicate false or improper operation, abnormal conditions or breakdown of processes, machinery or other plant equipment. Utilize drop, lamp, or bulls-eye light indications.

**General Industrial Signals & Contact Devices**—bells, horns, buzzers, chimes, sirens, push buttons, lights, door openers, transformers all contribute to more efficient plant and office operation.



**EDWARDS**

*specialists in signaling since 1872*

**CONTROL  
COMMUNICATION  
PROTECTION**

Emil Gabriel says: \*

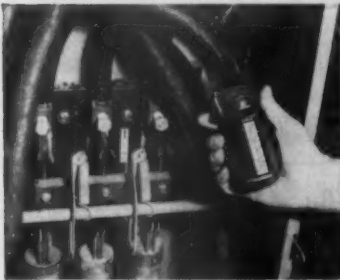
## "WE CUT MOTOR-TEST TIME WITH THE AMPROBE RS-3!"

"Ours is a very busy motor-repair shop. With the amount of work we handle, any method of cutting corners is appreciated. One of the best ways of cutting test time we've found is to make sure that *every* man in the shop has an AMPROBE RS-3 snap-around volt-ammeter-ohmmeter. We've been using the RS-3 for some time now, and it saves us time, effort and trouble on every motor job. We wouldn't be without the RS-3!"

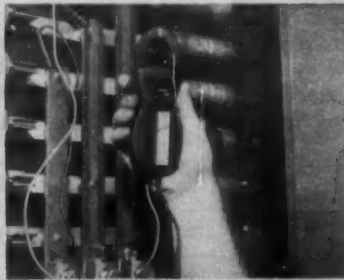
Not only do Emil and his men at Queens Electric use the AMPROBE RS-3 but they recommend it to their customers for plant maintenance. Yes, thousands of electricians, servicemen and plant maintenance men everywhere have discovered that the all-purpose AMPROBE RS-3 handles 99% of all their test needs...accurately and safely. It meets every commercial voltage requirement on three voltage scales...0-150/300/600 VAC; gives accurate current readings from 0 to 300 amps on five current ranges; takes resistance readings as low as 0.5 ohms. *Cut motor-troubleshooting time — mail coupon today!*



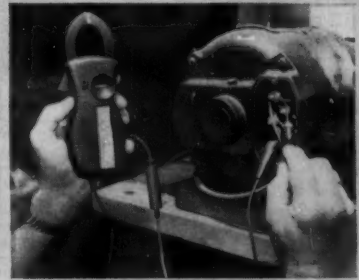
\*Veteran shop foreman, Queens Electric Motors, Long Island City, N. Y.



Check phase balance on new installations



Check for low-voltage conditions



Check unmarked terminals on motors

## AMPROBE RS-3

Pyramid Instrument Corp. Dept. T-1,  
630 Merrick Road, Lynbrook, L. I., N. Y.

I'd like to know more about how Emil and his men use the AMPROBE RS-3. Please send me detailed story.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

## How to choose the right diffuser for fluorescent lighting applications

Published as a service to the lighting industry  
by Lighting Products Inc., Highland Park, Illinois

Fluorescent lighting diffusers should be designed to achieve proper brightness balance and even light distribution. They shield light, transmit it, redirect or diffuse it. They do this by means of metal or plastic "egg crates," baffle systems, or complex configurations of plastic and glass. Some diffusers serve the added function of preventing dust or moisture from entering the luminaire.

Selection of the right diffuser for an application is based on the illumination control that is required as well as economic and esthetic considerations. The table below is designed to aid in making a choice among ten typical diffusers on the basis of their relative costs and of their brightness control at six

angles of vision as well as control of brightness on the visual task itself.

The relative costs of diffusers listed in the table are represented by index figures. In calculating the cost index of any diffuser, maintenance is an important consideration. The diffuser should be easy to clean and durable enough to withstand normal cleaning and maintenance over a period of many years. These factors are reflected in the figures given. The acrylic formed diffuser is used as a base at 100. Comparative cost indexes for other types of diffusers follow in decreasing order. The vinyl pan is rated at 20 and costs only one-fifth as much as acrylic formed diffuser.

DIFFUSER SELECTION TABLE

Type of Diffuser	Relative Cost Index	Maximum brightness in footlamberts at indicated viewing angles for both crosswise and lengthwise shielding — measured on typical 2x4 troffer with four 40w rapid start lamps.											
		Nadir		45°		55°		65°		75°		85°	
		Cross-wise	Length-wise	Cross-wise	Length-wise	Cross-wise	Length-wise	Cross-wise	Length-wise	Cross-wise	Length-wise	Cross-wise	Length-wise
Acrylic Formed Diffuser	100	750	760	680	680	650	640	625	600	550	540	440	425
Hex Aluminum Louver	80	Lamp Brightness		640	640	450	400	325	350	225	250	140	185
Fiberglass Flat Sheet	80	1150	1000	860	780	700	600	550	500	450	450	380	400
Vinyl Circular Louver Grid, White	52	Lamp Brightness		800	700	650	500	450	400	380	350	300	275
Vinyl Circular Louver Grid, Gray	52	Lamp Brightness		800	700	600	550	425	400	275	250	180	150
Pigmented Ventrolens Diffuser	32	850	860	700	650	590	550	490	480	450	450	375	400
Gray 1/2"-Cell Plastic Louver	32	Lamp Brightness		650	725	500	475	400	375	320	300	225	250
Clear Prismatic Ventrolens Diffuser	30	1650	1650	1020	800	650	500	480	400	375	325	260	180
White 1/2"-Cell Plastic Louver	30	Lamp Brightness		650	680	500	650	450	625	380	550	350	325
Formed Vinyl Pan	20	750	750	750	740	725	700	650	625	600	600	600	575



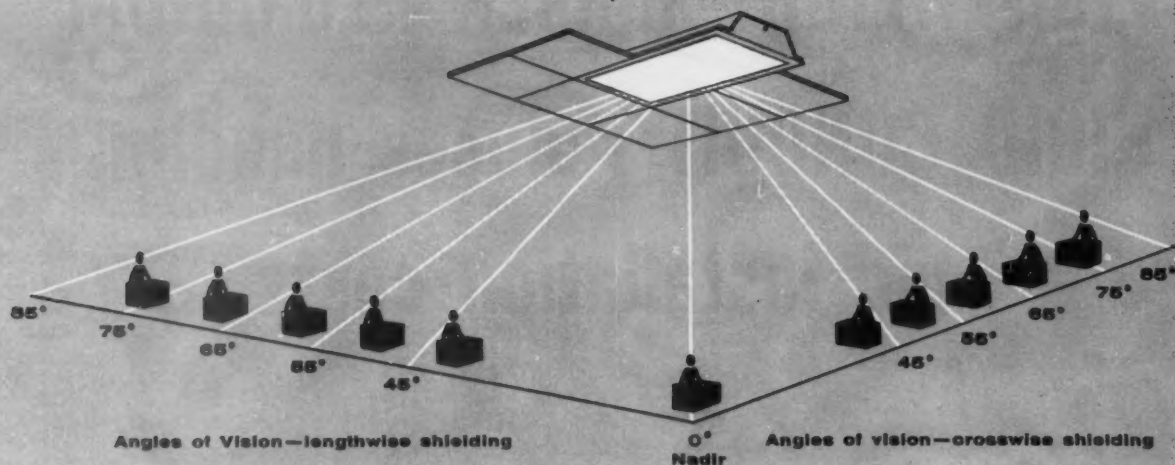


Illustration shows viewing angles at which brightness values were measured for ten types of diffusers. Results for both crosswise and lengthwise shielding are shown on Diffuser Selection Table.

Once the desired lighting level and the type of fixture required for an installation are determined, a diffuser with the proper characteristics for the application should be selected. The table will aid in determining which diffuser best meets brightness requirements. It shows brightness in footlamberts for the ten types of diffusers and at six angles of view — both lengthwise and crosswise as illustrated in the diagram above.

These angles of view are significant in relation to the size of the room. For a large room, it is important to consider brightness at low angles because raising the line of sight 10 to 15 degrees may bring the luminous section of the diffuser into sight. In small rooms, viewing angles in the 45 to 65 degree zone may be of greater importance.

Brightness at nadir is a meaningful factor when considering glare. If reflectance of a lamp from a work surface is objectionable, a diffuser which shields lamp brightness in this zone should be selected. Louver systems or grid type diffusers are less satisfactory than closed type diffusers for shielding

the brightness of the fluorescent lamp at nadir.

Note that pigmented-louver diffusers have significantly lower brightness at lower angles. For example, the vinyl circular louver grid in white is rated at 300 footlamberts at a viewing angle of 85°; the same diffuser in gray reduces brightness to 180 footlamberts. At nadir, both diffusers permit lamp brightness. The brightness of pigmented ventrolens at nadir is 850 footlamberts; at an angle of 85°, brightness is 375.

Diffusers have an important effect on the efficiency of the luminaire. A typical troffer has 67% efficiency using clear ventrolens diffuser. If the diffuser is pigmented to provide better control over direct glare, efficiency is reduced to 60%. Vinyl pan further reduces luminaire efficiency to 54%.

The table enables comparisons of performance and economic factors for the ten diffusers shown. Selecting a diffuser on the basis of this data makes it simpler to achieve a proper balance of lighting efficiency, pleasing appearance, and cost.

**Reprints available**—If you would like reprints of this discussion for your own use or for others in your organization, we will be pleased to provide them. Drop us a line mentioning the number of Diffuser Selection Reprints you would like. Also, please remember that your LPI representative is always ready to offer technical assistance on every aspect of fluorescent lighting.

Lighting Products Inc., Highland Park, Illinois

**LPI**

**FLUORESCENT  
LIGHTING**

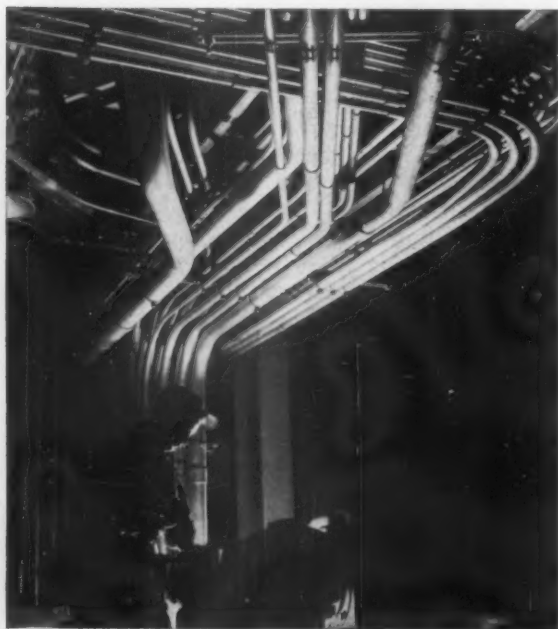
# LIGHTWEIGHT KAISER ALUMINUM RIGID CONDUIT reduces handling and installation costs

**WEIGHT COMPARISON, ALUMINUM VS. STEEL**

U.L. required minimum weight per  
100 ft. including couplings, lbs.

Trade Size, Inches	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6
ALUMINUM	27.4	36.4	53.0	69.6	86.2	115.7	182.5	238.9	287.7	340.0	465.4	612.9
STEEL	79.0	105.0	153.0	201.0	249.0	334.0	527.0	690.0	831.0	982.0	1334.0	1771.0

This chart shows 66% reductions in the weight of aluminum conduit as compared to steel conduit. Result: easier handling, reduction in worker fatigue, lower labor costs.



**CHECK** the chart . . . aluminum conduit weighs only *one-third as much* as steel conduit!

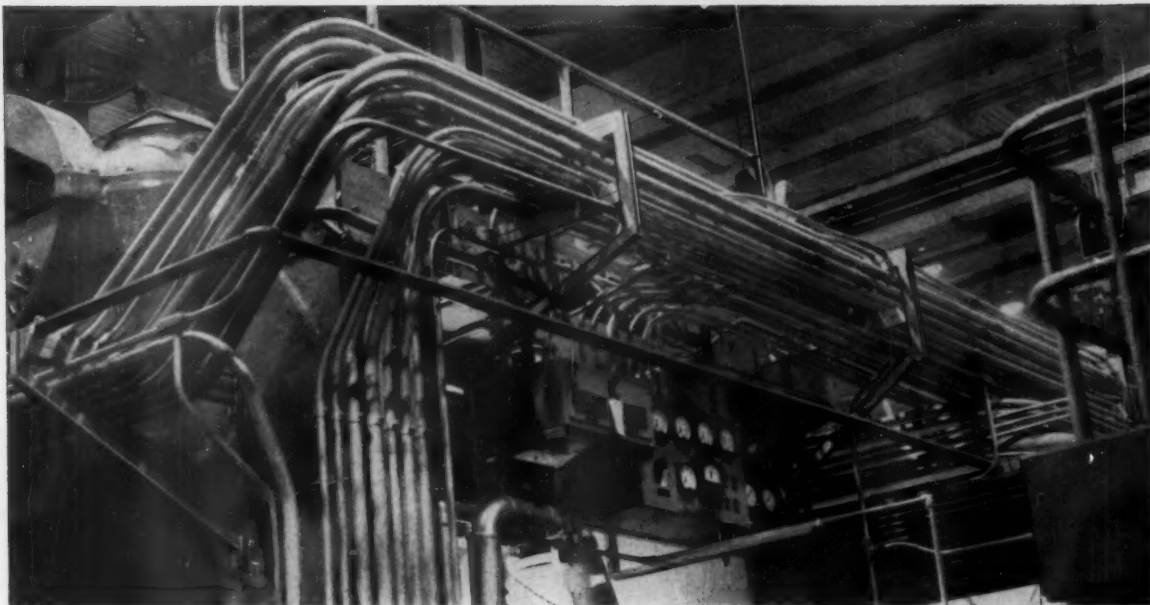
This lighter weight pays off in faster installation with less worker fatigue. Result: lower installation costs . . . with savings up to 50% in some cases!

And here's another cost-saver: lightweight aluminum conduit requires fewer hangers or supports. For large cable-conduit feeders in sizable groups or banks, the number of supports can be greatly reduced. Definite labor savings can be made, especially where supports must be installed in masonry with star drills.

Aluminum conduit's lighter weight pays off in lower handling costs too. For example, standard 10-foot lengths of 3/4" steel conduit, usually delivered in groups of five, weigh 53 pounds delivered. Similar aluminum conduit, *delivered in groups of ten*, weighs only 37 pounds.

## **Corrosion Resistant To Cut Maintenance Costs**

The excellent resistance of aluminum to atmospheric



and chemical corrosion has been proved by numerous and extended exposure and laboratory tests, and by countless applications in the process industries.

Aluminum's ability to resist corrosion means that maintenance is virtually eliminated. No painting is needed. Replacement costs are held to an absolute minimum.

And, since aluminum can't rust, cost economies can also be realized in storage. No special storage preparations are necessary.

#### Nonmagnetic To Reduce Voltage Drop

Because aluminum conduit is nonmagnetic, it is not subject to magnetically-induced energy losses.

This reduction of energy loss permits a longer run of cable without exceeding the voltage drop as specified in the National Electrical Code. In some installations this will permit the use of a smaller size conductor and conduit.

A further advantage is that each conductor in

either a single-phase or polyphase system can be enclosed in a separate aluminum conduit, regardless of electrical load. Separate rigid conduits greatly simplify installation of electrical equipment having widely spaced terminals. Terminal overcrowding is eliminated.

#### Get ALL The Facts Now!

We will be glad to send you an informative 9-page magazine article entitled "Now We Can Specify Aluminum Conduit."

This article contains a complete run-down on the advantages of using aluminum conduit—comparative conduit weights, comparative labor cost charts, installation facts, and much more valuable information.

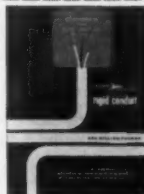
We'll also send our *Aluminum Rigid Conduit* brochure, with installation data, specifications and availabilities for Kaiser Aluminum rigid conduit.

Get *all* the facts about aluminum rigid conduit and how it can save you money. Mail the coupon now!



**IF IT CARRIES CURRENT, ~~K~~ CARRIES IT!**

See Aluminum Conduit featured on "Maverick"



Kaiser Aluminum & Chemical Sales, Inc.  
Electrical Conductor Division  
Dept. C0-129  
1924 Broadway, Oakland 12, California

Please send your *Aluminum Rigid Conduit* brochure and aluminum conduit magazine article.

NAME

ADDRESS

CITY  STATE

# triples gross with Berko electric radiant heating!

**Chicago Heights contractor used to gross \$700 per home . . . now averages more than \$2,000!**

"We almost had to give it away!" says Harold Hensley, owner of Hensley Electric Co. when he talks about his early start in electric heating. Today, six years later and with a backlog of business that's the talk of the area, the situation is quite reversed. Hensley reports that in two similar projects with homes in the \$20,000 range, the project without electric heating had electrical work valued at \$700 per home. In the one with electric heating, Hensley's gross comes to more than \$2,000 per home! The interesting fact is that electric heating alone does not account for all of this larger gross. Hensley has found that builders are willing, even anxious, to upgrade the quality and extent of the entire electrical installation when electric heating is installed.

## **BERKO WAS THE DIFFERENCE**

"Growing up in the electric heating business was rough," Mr. Hensley says. "We had trouble with some types and makes of electric heaters and researched and tested all of them. We finally settled on Berko glass radiant panels. Customers liked the appearance and radiant heating; we liked the fast installation and reliability. We've never had a make-good!"

"Once we decided on the product, we began to advertise it in our local papers and talked electric heating whenever and wherever we could. Then when we got a few jobs in—mostly supplementary heating—electric heating really began to take off. Instead of a heater for the bathroom or a couple of panels for the porch, we were converting older homes to electric heating, and putting it in new homes."

## **"BERKO PANELS ARE MOST VERSATILE OF ALL"**

"Nothing can burn up a crew's time and my profit margin like installation troubles. Berko's heaters, particularly their baseboard units, are designed with the contractor in mind. Their flexibility in installation after the house is roughed in has been responsible for increasing my profits on many housing jobs."

## **BERKO OPENS THE DOORS TO BIG BUILDERS...**

"I am now working on fifteen new housing developments," Mr. Hensley declares. "Not all of them specify electric heating, but electric heating has been responsible for getting me started with the builders. Previously these builders were satisfied with their electrical contractors and many wouldn't even talk to me. Then as their interest—and my reputation—in electric heating grew, and as they saw their competitors sell-out projects where I had installed Berko electric heating, they invited me to bid. My experience with Berko was the only edge I had over their regular contractors, but I got the jobs."

## **...AND TO BIG BUSINESS!**

"We are so busy working on project homes we can't spare crews for individual homes right now. We have had to suspend our advertising. But we still get inquiries every day. I don't know who will be putting in these installations until we can get around to them, but I do know there's an awful lot of Berko business waiting for any contractor who doesn't mind reaching to pick up the order!"



*Harold Hensley,  
owner of  
Hensley Electric Co.,  
Chicago Heights*



*Hensley going over plans for a Berko installation with one of his foremen. From the "blues," he makes his own electrical installation plans for each crew to follow.*



*Hensley gives much of the credit for increased profits to the speed and simplicity with which Berko panels are installed.*



*Berko baseboard glass radiant panels with duplex receptacles installed beneath picture window in project home. (Inset) Henry Berg & Son model home, Chicago Heights . . . transformed by electric heating from an ordinary wiring job to an impressive quality electrical installation. Hensley Electric is installing Berko glass radiant heating in 80 homes of this project.*

For information about the complete Berko line write Dept. ECM-10

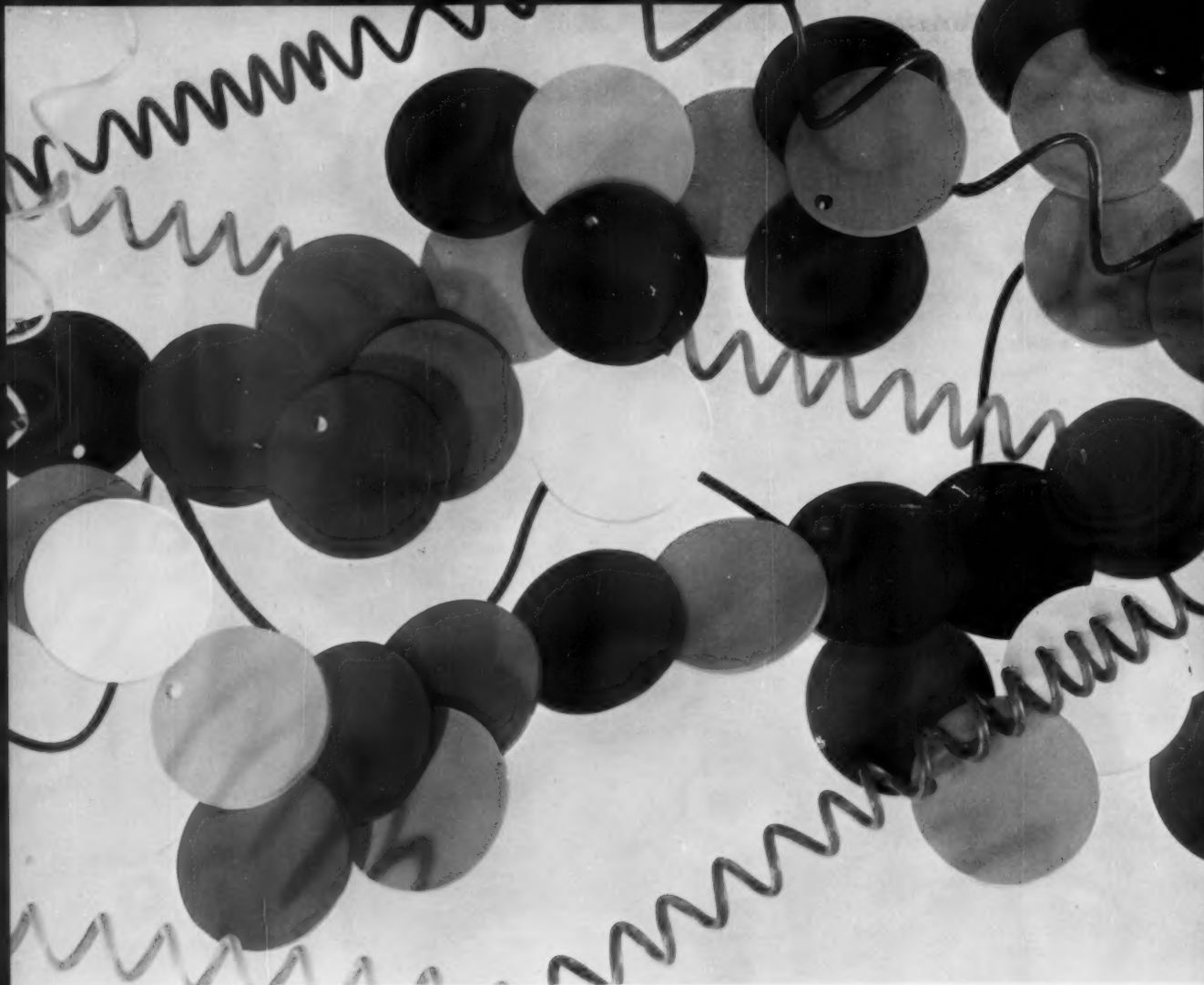
# BERKO

**BERKO ELECTRIC MANUFACTURING CORP.**  
212-40 JAMAICA AVENUE, QUEENS VILLAGE 28, N. Y.



# Naugatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



## Need color in a weather-resistant rubber product?

PARACRIL® OZO will give you all the color you want... any color... permanent, gleaming color for every kind of rubber product, from electric wire to oil pump hose to shoe soles.

Now you can give your product powerful extra selling features... color that attracts, that warns, that identifies, that helps emphasize or hide.

Along with color, PARACRIL OZO gives you a combina-

tion of weather resistance, abrasion resistance, oil resistance, flex life and other valuable rubber properties far surpassing conventional weather-resistant rubbers.

See if your product doesn't call for PARACRIL OZO. To find out more about this proven new rubber and the properties it offers your product, contact your Naugatuck Representative or write us today.



## Naugatuck Chemical

Division of United States Rubber Company

1034P Elm Street  
Naugatuck, Connecticut



# McGILL® PORTABLE LAMP GUARDS

## are always a little better

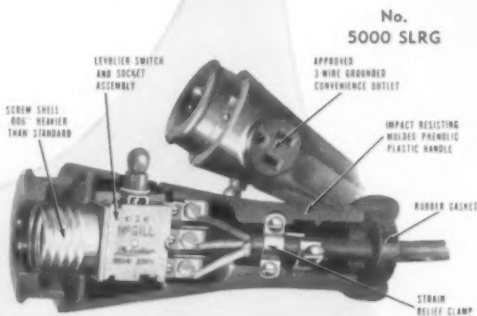
## ...and all are UL inspected

- Rugged, steel wire cage. Spot-welded with extra heavy zinc plated, chromate finish.
- Tough, gray molded phenolic handle resists impact, heat oils, greases, some acids, moisture and abrasion.
- Concentrating end lens. • Convenience hook.
- Approved 3-wire grounded convenience outlet.
- Exclusive McGill LEVOLIER Switch. • Rotary reflector.

An extra margin of quality is designed and built into the complete line of McGill industrial portable lamp guards for safe, dependable utility. Rugged, heavy duty construction and selected materials withstand the punishment of rough use. The famous McGill LEVOLIER switch mechanism provides a degree of dependability not found in ordinary portables. It's economical to specify the best.

More than 100 different types of McGill portable lamp guards have been developed to meet the particular requirements of a wide range of service conditions. Cages 50 to 200 watt. 660 watt, 250 volt sockets.

For detailed descriptions of the McGill line of top quality electrical specialties, including portable lamp guards, and Levolver switches write for McGill ELECTRICAL SPECIALTIES CATALOG No. 84.



No. 7100 SR Lamp Guard

Thumb clamp arrangement for cage to change lamps quickly without tools. Gray Neoprene-butyl handle; reflector; LEVOLIER switch.



No. 5025 SRG Service Light

Completely grounded service light. 15 amp., 125 volt convenience outlet built into molded phenolic handle. Safe on-the-job source for power tools. Levolver switch and 25 ft. 16-3-SJ gray rubber cord.

No. 5000 SR Lamp Guard

With 15 amp., 125 volt convenience outlet in impact and heat and grease-resisting positively insulating molded phenolic handle. No-Rol cage, Levolver switch and reflector.

No. 3006 Vaporproof Lamp Guard

Watertight, vaporproof and moistureproof for complete safety. Heat and impact resisting glass globe screws into a silicone rubber gasket. Handle molded of macerated phenolic.



No. 652 Lamp Guard

Rubber hook handle, thumb release clamp for easy bulb replacement. Can be hung, for maximum light, from hook or handle.

Write for Free McGill Catalog No. 84

engineered electrical products

# McGILL



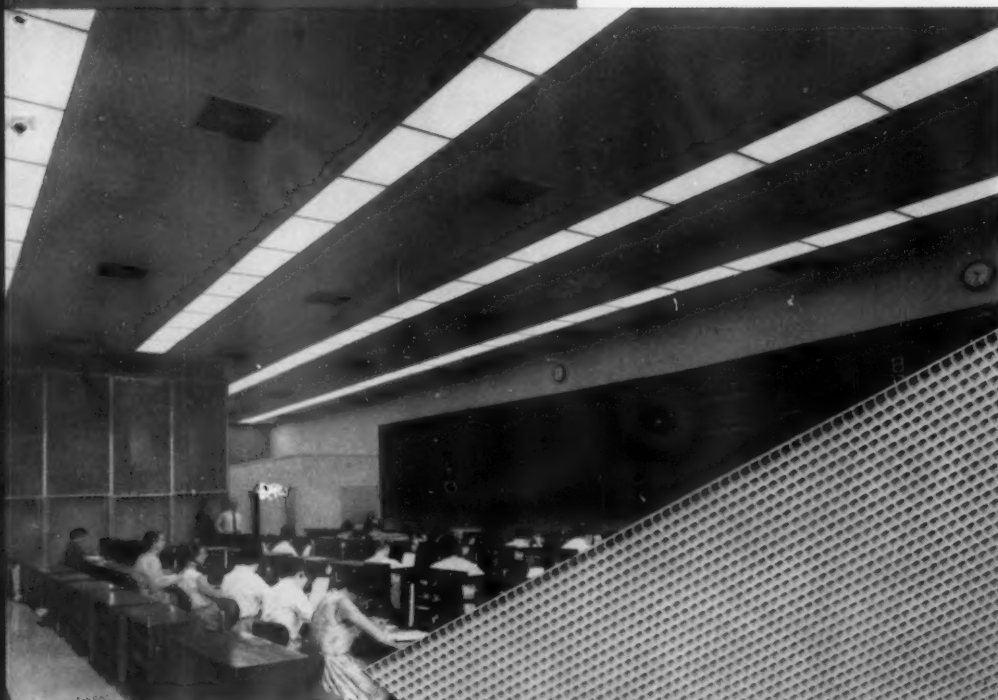
precision needle roller bearings

McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

American louvers exclusive design and construction provide highly efficient lighting levels, without glare—they conform to or above the standard recommendations for proper light shielding—Leading architects and consulting engineers specify and use American plastic louvers due to their versatility and easy adaptability to most lighting installations.

## eastern air lines feature american plastic louvers—

for perfect shielding with  
unexcelled seeing comfort  
and efficiency required for  
today's high-speed service.....



**PERMANENT COLOR STABILITY**  
**HIGH IMPACT FOR GREATER STRENGTH**  
**EASY TO HANDLE—LIGHT WEIGHT**  
**5/8" CELLS 45° x 45° LIGHT CUTOFF**  
**FOR GREATER LIGHT TRANSMISSION**  
**PATENTED INTERLOCKING LOUVERS**  
**ASSURE PERFECT ALIGNMENT**  
**LOW COST UPKEEP—EASY TO CLEAN**  
**AVAILABLE IN COMBINATION OF SIZES**  
**LOUVERS MAY BE CUT TO SPECIFICATIONS**

*Louvers in white ...*

*also available in pastel colors of  
blue, pink, green, yellow and low brightness*

Engineers are available in your area to help with your lighting problems or write American Louver Company direct.

Exclusive process by American Louver Company  
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**american louver company**

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**CUTS**  
assembly time  
**26%**



## *New* **ORANGEBURG® CA\* CONDUIT** *with Flush Coupling Attached!*

With no separate couplings to handle or attach on the job, Orangeburg CA lays faster, costs less to install. Each long, light length has a *flush* coupling attached at one end and a standard 2" male taper at the other end, making installation a simple, one-step operation. And, since the coupling is attached, there are no coupling cartons to warehouse or carry to the job.

What's more, with the coupling *flush* to the conduit's outside wall, new CA is easy to stack, store and handle. The flush coupling also eliminates "staggered" joints in the trench. And that means real savings in cutting and tooling time. Like the hundreds of millions of feet of Orangeburg fibre

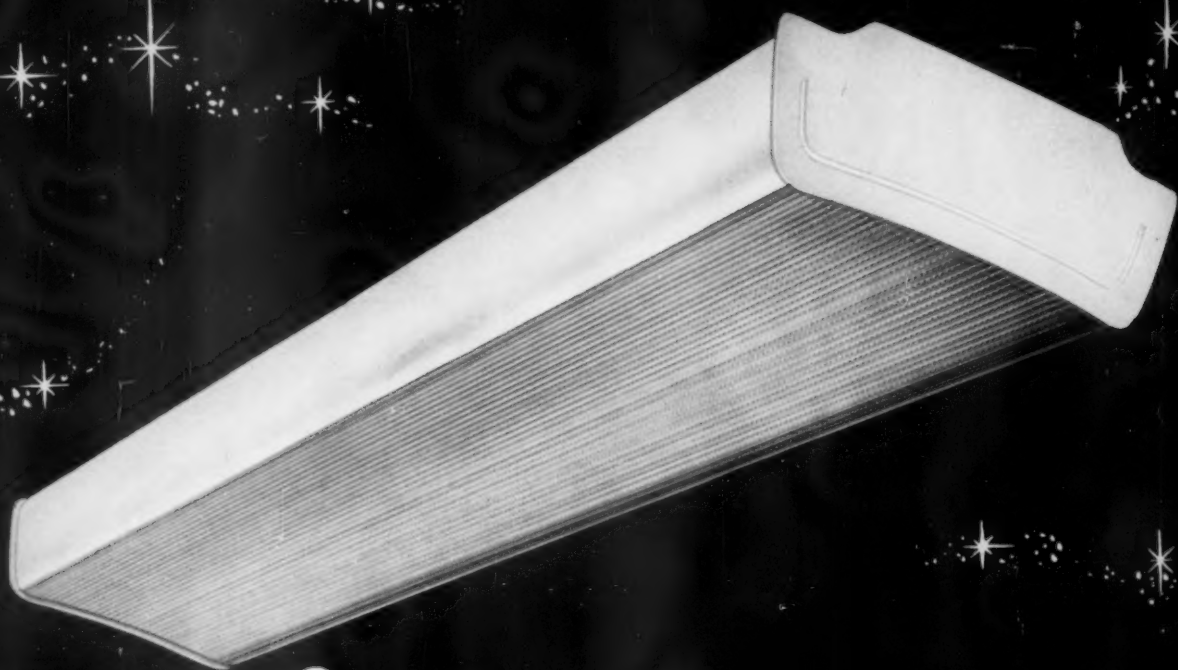
conduit in use since 1893, new CA has self-sealing joints and impermeable walls. Its smooth, 100% fibre raceway adds years to cable life.

New Orangeburg CA is available in 2", 3", 4", 4½" and 5" sizes. Orangeburg Standard and Nocrete Conduit, with separate sleeve couplings, are available as always. Write Dept. EC-109 for Catalog 52.

**ORANGEBURG MANUFACTURING CO.**  
Orangeburg, New York • Newark, California  
*A Division of The Flintkote Company, Manufacturers  
of America's Broadest Line of Building Products*

*Orangeburg Fibre Conduit is distributed by Graybar Electric Co. and General Electric Supply Co. with branches and stocks in principal cities.*





PREMIUM *Quality* IN THE GARCY TRADITION  
AVAILABLE NOW AT A LOW-BUDGET *Price*

**The New *Gar-Lite* 101 by GARCY LIGHTING**

Exclusive one-piece shield combines two tones, does two jobs

Diffuse white sides prevent objectionable side brightness

Clear prismatic bottom offers controlled high efficiency

Shield hangs down from either side on continuous hinge

Two-lamp unit (illustrated) is less than 9" wide, 3 $\frac{3}{4}$ " deep

Exact 48" length; joins end to end quickly and easily

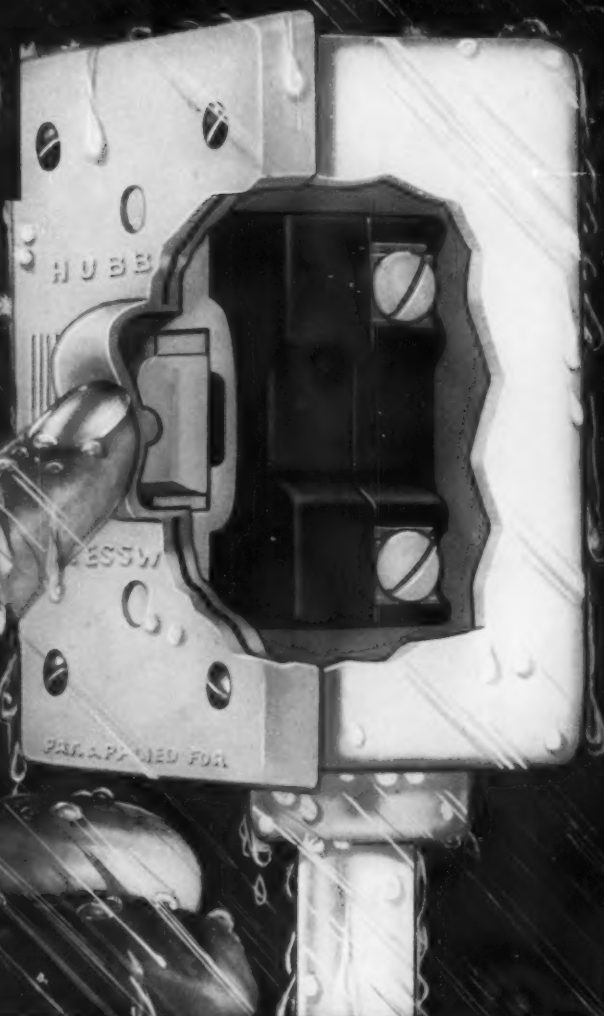
Write for Bulletin 59

AVAILABLE THROUGH SELECTED GAR-LITE DISTRIBUTORS

**GARCY LIGHTING**

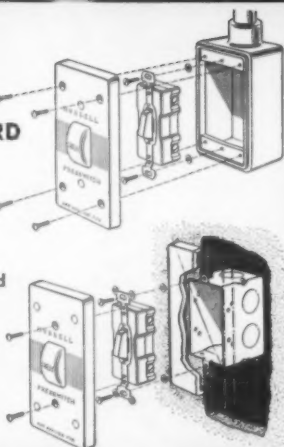
DIV. OF GARDEN CITY PLATING & MFG. CO.  
2475 ELSTON • CHICAGO 47, ILLINOIS

# WEATHER



## FITS BOTH FS AND STANDARD WALL BOXES

Finned, self-sealing  
mounting holes  
permit the  
"Insulprene"-sheathed  
plate to be  
fastened to  
FS or standard  
wall boxes.



EXPOSED PASSAGEWAYS



LOADING PLATFORMS

# PROOF

## "INSULPRENE" PLATE WITH A.C. "PRESSWITCH"

### SEALS OUT RAIN, SNOW, AND DUST

Moisture and dust cannot penetrate to the switching mechanism of this new Hubbell switch-and-plate combination.

The steel cover plate *and* the opening for the switch button are completely sheathed with a tough, flexible skin of "Insulprene", which prevents rusting and insulates wet hands from contact with metal. The "Presswitch" button is actuated simply by pressing the "Insulprene" bubble that covers it.

"Insulprene" is a DuPont neoprene-base plastic. It is non-conductive and highly resistant to impact, aging, oil, grease, live steam, hot water, extreme cold, heat and sunlight. For example, at the end of a 744-hour Atlas Weatherometer test simulating tropical rain and sunlight, the "Insulprene" bubble showed no significant loss of resiliency in operating the "Presswitch" button.

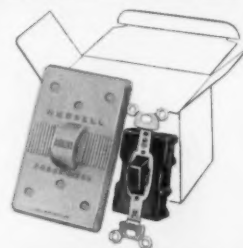
Hence this plate-and-switch combination is ideal for outdoor installations subject to severe weather conditions ( $-15^{\circ}$  F to  $150^{\circ}$  F) or greasy hands (*filling stations, parking lots, garages, truck docks, playgrounds, sports fields, exposed passageways and breezeways*) or for indoor installations where humidity is high or temperatures are low (*dairies, freezer plants, cold-storage rooms, shower rooms, laundries, etc.*)

Words "Insulprene" and "Presswitch" are Hubbell trademarks.

The switching mechanism is the fast-acting Hubbell "Presswitch", which responds to the gentlest touch of finger, hand, or elbow in any position. It is available in single or double pole, 3-way or 4-way action, in 15 or 20 ampere sizes for 120-277 volt A.C.

The "Insulprene" Plate and A.C. "Presswitch" combination is designed for FS or standard wall box mounting.

For further information about Hubbell rugged wiring devices, write to one of the offices listed below or refer to the Hubbell insert in the Architectural File of Sweet's Catalog (Sweet's No. 31b/Hu.)



#### PACKAGED TOGETHER FOR CONVENIENCE

The "Insulprene" Plate and A.C. "Presswitch" are delivered to the job as a unit in this time-saving package, with complete mounting instructions for FS or standard wall boxes. Plate is available in gray (No. 1751) or in "Chem Marine" Yellow (No. 17CM51).



DAIRIES

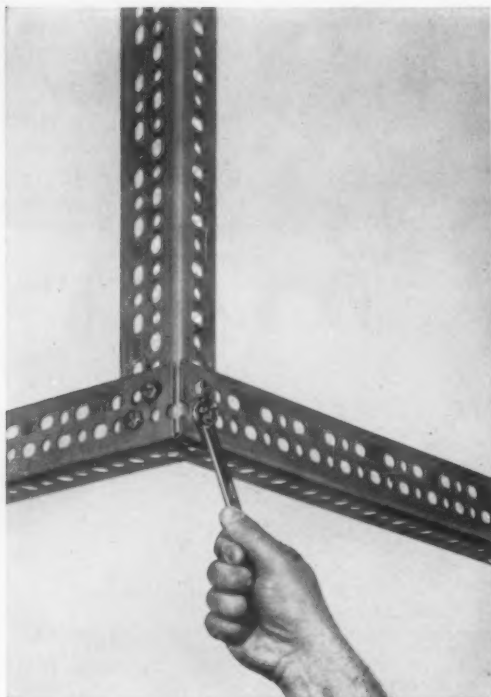


PATIOS OR SWIMMING POOLS

# HARVEY HUBBELL, INCORPORATED

BRIDGEPORT, CONNECTICUT

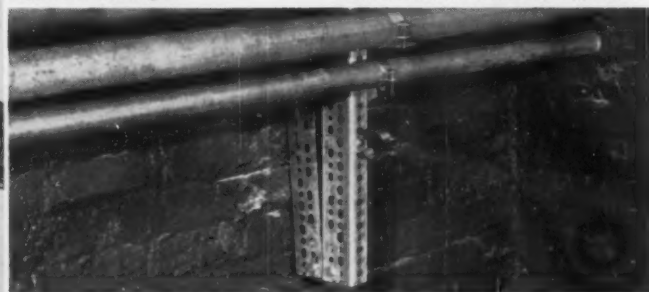
IN CANADA: SCARBOROUGH, ONTARIO



Support for switch gear



Protective barrier for electrical apparatus



Wall support for heavy, rigid conduit on uneven wall

## SAVE ON EVERY KIND OF INSTALLATION

# WITH **new** **AIM** BRAND **Slotted Angle**

Cut job costs on all your electrical installations with new AIM Brand Slotted Angle—the only framing material that gives you Lock-Joints, Friction-Joints and  $\frac{3}{8}$ " structural bolts.

It's easy and economical to use this new framing material as supports, framing, mountings or wherever you need strong, yet convenient, structural assembly. The exclusive new slot-and-hole bolting pattern provides ready-made openings for anchors and attachments. All standard electrical fittings can be used. No reaming is necessary.

Friction-Joints are quickly formed by bolting through the slots. The  $\frac{3}{8}$ " structural bolts fit round holes precisely to form Lock-Joints when maximum rigidity is needed. Each bolt has a safe load capacity of 2000 pounds.

Fabricate right on the job site with AIM Brand Slotted Angle. No drilling or welding is required. Save on installation time . . . save on initial material cost . . . save on handling and storing.

Of cold-rolled galvanized steel, this versatile framing material is available in two sizes: Standard 225-80 ( $2\frac{1}{4}$ "x $1\frac{1}{2}$ "x.080") and Heavy-duty 300-104 ( $3$ "x $1\frac{1}{2}$ "x.104"). Packaged in 10 or 12-foot lengths, ten pieces to a package. Nuts and bolts included.

AIM Brand Slotted Angle is a product of Acme Steel Company, U. S. pioneers in slotted angle framing material. Stocked locally by leading distributors or write: Dept. EBD-109, Fabricated Materials Division, Acme Steel Company, 135th and Perry Avenue, Chicago 27, Illinois.



## AIM Brand Slotted Angle







# PLEXIGLAS

...for lighting that stands out and stands up



Sixteen 4' x 4' pan-type diffusers of white translucent PLEXIGLAS are used to light the striking new branch office of Mechanics National Bank in Levittown, N. J. Architect: Clifford Garner.

Handsome buildings deserve the *best* in lighting, and they get it when lighting equipment includes diffusers or lenses made of PLEXIGLAS® acrylic plastic. PLEXIGLAS provides highest efficiency in transmission and diffusion. It is rigid, with a smooth, easily cleaned surface. Above all, it is a *durable* material—highly resistant to breakage, and free from discoloration even after years of exposure to fluorescent light.

We will be pleased to send you the names of manufacturers whose lighting equipment is based on the use of PLEXIGLAS.



*Chemicals for Industry*

**ROHM & HAAS  
COMPANY**

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

*In Canada: Rohm & Haas Company of Canada, Ltd., West Hill, Ontario*



# The Advantages of ADVANCE Kool Koil Fluorescent Lamp BALLASTS Come in 1969

*As time goes into the 1970's, you'll find ADVANCE Kool Koil Fluorescent Lamp Ballasts operating long after others have failed.*

ADVANCE engineers tested new grades of steel, larger diameter wire . . . developed special insulating materials and compounds . . . separated vital components in the ballast case so the capacitor would operate at temperatures far below its guarantee limits. Then, after three years of this exhaustive research ADVANCE perfected Kool Koil Fluorescent Lamp Ballasts . . . ballasts which operate 16.5°C. to 19.5°C. lower than any other ballast tested in a standard 40°C. C.B.M. and U/L heat box.

Because ballast life is cut in half for every 10°C. over normal operating temperatures, Kool Koil Ballasts operating up to 20°C. cooler give you extra years of trouble-free ballast operation and added protection that ends costly maintenance and interruptions in service.

Always insist on Kool Koil Fluorescent Lamp Ballasts . . . the extra benefits will come as time goes into the 1970's . . . and after.

*"The Heart of the Lighting Industry"*



**ADVANCE®**

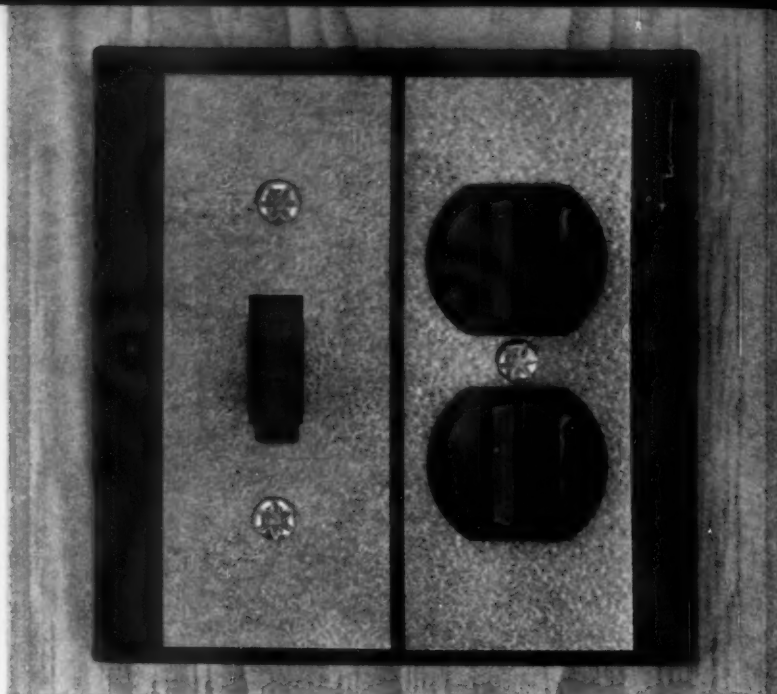
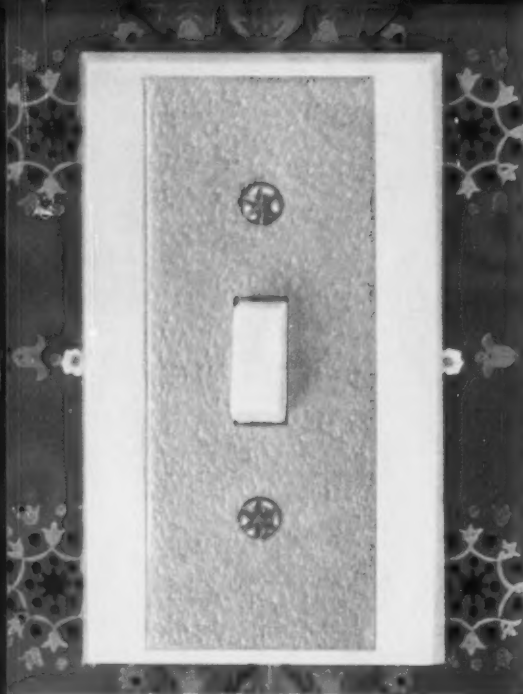


World's Largest Exclusive  
Manufacturer of  
Fluorescent Lamp Ballasts

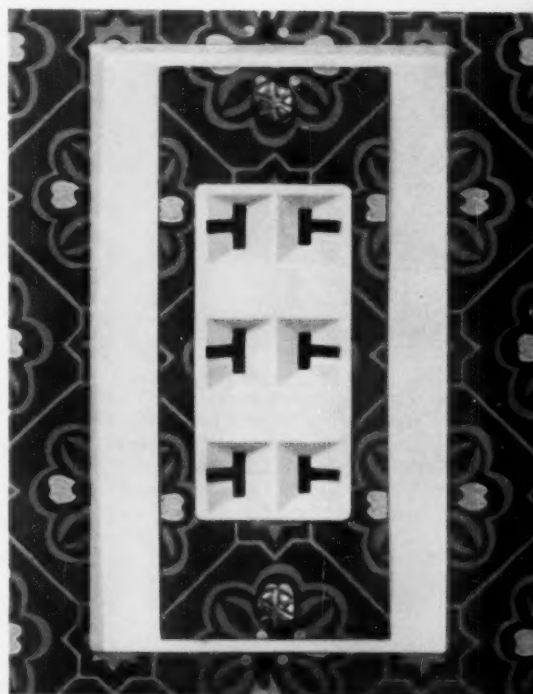
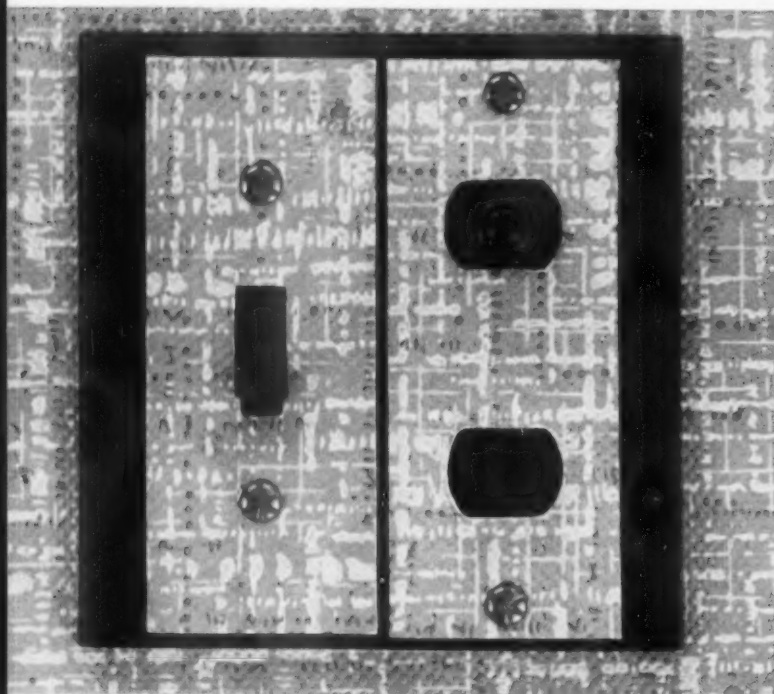


**TRANSFORMER CO.**

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.



**G-E Decorator Wall Plates** You can always make up the exact plate that you need — in just a few seconds — with the new G-E Decorator wall plate line. There's nothing to match it for convenience, for economy, for new decorative beauty!



See reverse side of this page for complete details

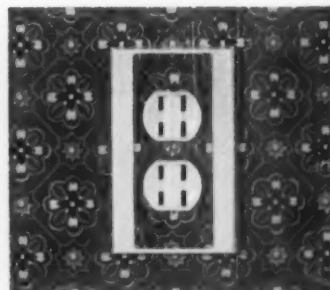
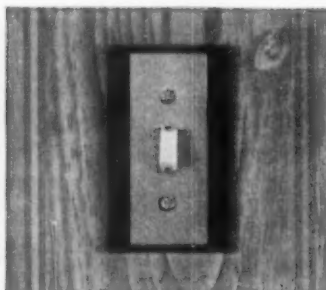
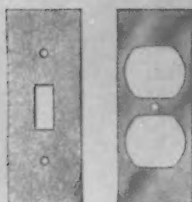
**GENERAL**  **ELECTRIC**

# New General Electric Decorator wall plates offer new "building block" flexibility

... more than 100,000 possible combinations!



+



Just take any plastic frame of the gang you need — in ivory or brown . . . Plus the inserts required (such as inserts for switch and 4-plug outlet illustrated) . . . to get the exact combination you need

## Choice of insert styles to suit any customer

All General Electric Decorator wall plate inserts are available in metal and in clear plastic. The metal inserts are reversible; finished in rich, textured silver color on one side — gleaming, textured gold color on the other. The clear plastic inserts are designed so that paint, wall-paper or drapery fabric placed behind them will "show through."

For a special feature in new homes, metal inserts can be installed with either gold or silver sides showing — clear plastic inserts left behind for the housewife to use. She can then get special decorative effects with paint or paper — match her own decor.

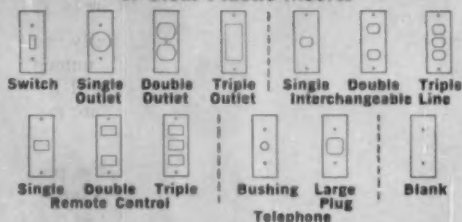
(Each insert package contains one metal insert, one clear plastic insert, and screws.)

A few basic frames and inserts fit all switch-outlet wall plate combinations that are required for residential, commercial, and industrial applications.

## Sculptured plastic frames in brown or ivory



## Reversible Gold-Silver Colored Metal or Clear Plastic Inserts



## Compact new metal kit carries full assortment

This new kit contains several of all frames and inserts you need for any plate combination, including extra pieces for the most frequently used plates — eliminates inventory problems, saves extra trips to your supplier.



## GET YOUR KIT NOW . . . WITH FREE BONUS!

For a limited time only, you will get free samples of the new G-E lighted push-button switch and the new G-E 4-plug outlet in each new wall plate kit. Ask your General Electric distributor now for the "G-E Decorator Wall Plate Contractor's Kit." Or, write General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**



# New Service Factor Motors Cut Costs



**Specify High Service Factor Motors for lowest initial cost, lowest operating costs . . . maximum reliability.**

Leading manufacturers now offer motors designed to an entirely new concept. These motors are available in standard NEMA frames of the same size used for conventional motors of the same rating, but look alike don't perform alike.

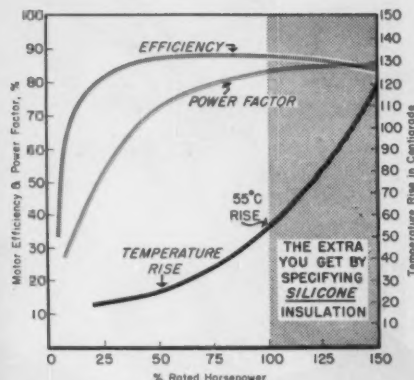
These new motors, insulated with Dow Corning Silicones, have a built-in reserve to carry overloads of twenty-five to fifty percent above nameplate horsepower rating. Here's what this means to you:

**Simplified Motor Specifications:** Specify motors that are silicone insulated for high service factor. With nameplate horsepower ratings identical to nominal loads, these motors will handle temporary, or even continuous overloading. No need to calculate maximum possible load and add a safety factor. It's already built in.

**More Efficient Power Use:** Power factor problems are reduced . . . excessive power bills resulting from part-load motor inefficiencies are brought in line. Because motors operate at rated output, the need for capacitors to correct power factor is substantially reduced.

**Less Installed Horsepower:** With motors rated to match normal loads, total installed plant horsepower will be substantially less. Using conventional methods of determining distribution system needs, transformer and switchgear requirements are lower—less costly units can be safely specified.

Motors insulated with Dow Corning Silicones for high service factors are available now from leading motor builders. For more information on what silicone insulated equipment can mean to you, write Dept. 3922.



How do manufacturers build so much extra into a motor? By substituting an insulation system made from Dow Corning Silicones for the Class A insulation system used in standard lines. Only the insulation changes. Frame, electrical steel and copper remains the same. And there's one change on the nameplate.

Service factor rating goes up. On a TEFC motor, for example, service factor goes up from 1.00 with Class A insulation materials to somewhere between 1.25 and 1.50 when silicones are used, depending on manufacture and horsepower rating.



Handling liquid of varying viscosity, this 5 hp, 125 service factor motor withstands overloads, including those created by excessive tightening of pump packing glands.

Motors insulated with Dow Corning Silicones give reliable operation in almost any surroundings—regardless of high ambients, moisture, many corrosive atmospheres. And on the basis of capability, high service factor motors generally cost less than conventional motors.

**SPECIFY Dow Corning Silicones  
and SAVE!**



**Dow Corning CORPORATION**  
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.



THE "CLASSIC" WITH METAL LOUVERS

## Go modern with Sylvania's New **CLASSIC** Series

*... a Triumph of Fixture Design!*

"The finest suspension mounted fixture in years"—this will be your reaction when you've seen Sylvania's exciting new fixture series, the CLASSIC. Here is a fixture in a class all its own . . . one that will take a prominent place

To develop a completely fresh and different approach to lighting fixture design, Sylvania retained the services of the renowned industrial designing firm, Peter Muller-Munk Associates.

The result of months of concentrated effort by this firm and Sylvania's own design engineers is presented here for the first time—the CLASSIC Series.

We sincerely believe that the CLASSIC is the very finest fluorescent fixture produced in a long number of years.



Pendant mounting with diffused plastic panel



Close ceiling mounting with plastic louvers

in your lighting plans.

The CLASSIC is *really* new . . . designed by experts to give commercial interiors a fresh, distinctive appearance together with outstanding illumination.

You'll like the sleek, trim lines and slim shallowness of this fixture . . . the flared, softly-diffusing side panels . . . the harmonious matching of plastic and metal . . . and the choice of three excellent shieldings.

You'll like its lighting characteristics, too. The extremely high efficiency, balanced distribution, low brightness contrasts and excellent diffusion of the CLASSIC makes it ideal for every commercial application.

To fully appreciate the CLASSIC, you must see it for yourself. Photographs and sketches cannot show the true beauty of this new series. Send today for full information. At the same time ask to have the CLASSIC demonstrated in your own office. Once you've seen it, you'll agree that this Sylvania fixture is truly a triumph of fixture design.

SYLVANIA LIGHTING PRODUCTS  
A Division of SYLVANIA ELECTRIC PRODUCTS INC.  
Department 59-4  
One 48th Street, Wheeling, West Virginia

GO MODERN WITH LIGHTING BY



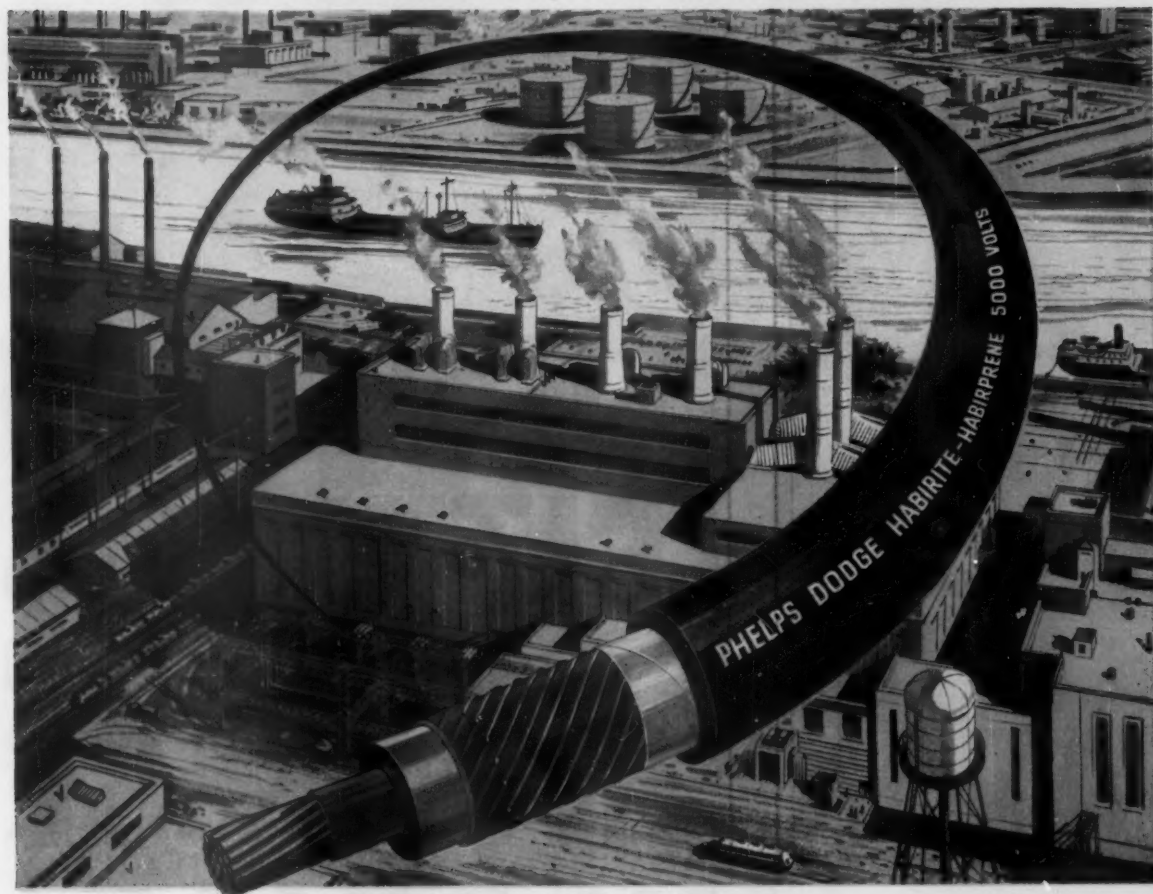
# SYLVANIA

Subsidiary of  
GENERAL TELEPHONE & ELECTRONICS



FLUORESCENT LIGHTING FIXTURES AND SYSTEMS • BEST FIXTURE VALUE IN EVERY PRICE RANGE

WHEN ORDERING "TYPE RR" CABLE...



## SPECIFY HABIIRITE-HABIIRPRENE

The high voltage cable that assures superior quality and service reliability!

The term "RR" is only a name, not an assurance of quality. Instead of ordering just "RR" cable, insist on Phelps Dodge *Habirite-Habirprene*—developed through years of experience in designing and manufacturing this type of cable.

Phelps Dodge Habirite insulation, a specially engineered butyl rubber compound, has a service dependability record unsurpassed by other types of rubber insulation. Habirite is greatly superior to old-fashioned insulation for these reasons:

- Much greater resistance to heat and oxidation which permits a higher temperature rating, with consequent reduction in conductor size and in cost for same current load.
- Much greater resistance to ozone usually present around high voltage equipment.
- Better electrical properties that give a greater safety factor in operation.

Phelps Dodge Habirprene sheath, a neoprene compound with improved

mechanical toughness against damage from installation hazards, is especially made to be extra resistant to corona, one of the worst enemies of high voltage cable. This extra resistance provides a greater safety factor in operation and has contributed to the remarkable reputation and service record of *Habirite-Habirprene*.

When you specify *Habirite-Habirprene*, you are assured of high voltage cable with the utmost in safety and durability. See your Phelps Dodge Distributor!

PHELPS DODGE COPPER PRODUCTS  
CORPORATION



SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

# now! OZ

## ALUMINUM FITTINGS

[FOR ALUMINUM CONDUIT]

# AT NO INCREASE IN PRICE!

O.Z. now offers a full line of aluminum fittings, keeping pace with increased demands for rigid aluminum conduit... Cable Supports, Expansion Fittings, End Fittings, Split Couplings, Pull Box Fittings, U-Bolts, Terminators, Flanges and O.Z. Types "B", and "SB", Bushings. Here is a premium line of fittings — at standard prices. O.Z. Aluminum Fittings are identical in design, workmanship and quality to similar O.Z. products in malleable iron and other metals. Whatever your requirements, O.Z. has the type and size you need.

When ordering any of the standard fittings illustrated, specify "aluminum" after the catalog number.

O.Z. Aluminum Conduit Fittings are at your local distributor now. For more complete information, see your distributor, or write direct to the company.



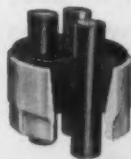


## CABLE SUPPORTS

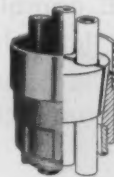
TYPE "S"



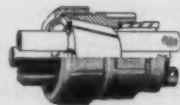
TYPE "R"



TYPE "C"

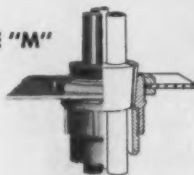


TYPE "K"



TYPE "W"

TYPE "M"



## BUSHINGS



TYPE "B"



TYPE "SB"

## EXPANSION FITTINGS



TYPE "EX"



TYPE "AX"



TYPE "EXE"



TYPE "DX"

Patented

## CABLE TERMINATORS

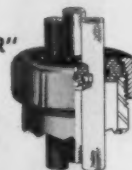
TYPE "FR"  
COMPOUND  
BUSHINGS



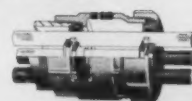
TYPE "DTC"  
WITH  
TAPING  
CONES



TYPE "KR"  
SEALING  
BUSHING



TYPE "CRH"



HORIZONTAL TERMINATOR

TYPE "CRC"  
WITH  
TOP  
COVER



TYPE "CLN"  
WITH  
TOP  
THREAD



## PULL BOX FITTINGS

TYPE "PB"



NON-WEATHERTIGHT

TYPE "PBW"



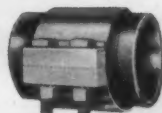
WEATHERTIGHT

## END FITTINGS



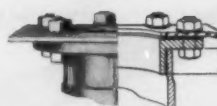
TYPE "E"

## SPLIT COUPLINGS



TYPE "SP"

## FLANGES



UNIVERSAL FLANGES

## U-BOLTS



Priced same as Bronze U-Bolts

# O.Z.

ELECTRICAL MANUFACTURING CO., INC.

262 BOND STREET • BROOKLYN 17, N. Y.

Sales Office and Warehouse: 406 So. Cicero Avenue, Chicago 44, Ill. • Esterbrook 9-0326  
Office and Factory: 749 Bryant Street, San Francisco 7, Calif. • GARfield 1-7846



- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

## NOW UNI-FRAME BECOMES A COMPLETE LENS BOX LINE

with new 10-inch size, new diffusing glass bowl and new splay trims. Choose from 24 possible UNI-FRAME combinations. For details, call your Day-Brite representative listed in the Yellow Pages or write DAY-BRITE LIGHTING, INC., ST. LOUIS 15, MISSOURI • SANTA CLARA, CALIFORNIA  
NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

DECIDEDLY BETTER  
**DAY-BRITE**  
LIGHTING FIXTURES

A-584

### choice of SIZE

10-inch for 150-watt lamp  
at new lower price

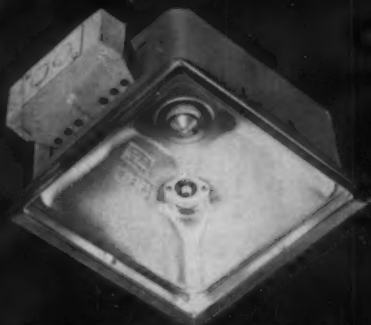
12-inch size for  
200- or 300-watt lamp

### choice of FINISH

White Enamel  
Aluminum  
Brass

### choice of SPLAY (OPTIONAL)

White Enamel  
Aluminum  
Brass Finish



Basic UNI-FRAME lens box  
(Patents Pending)

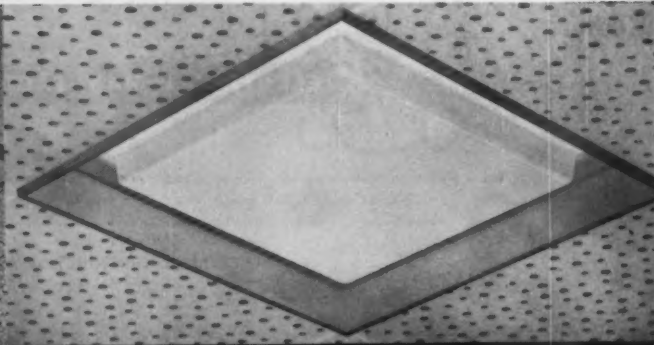
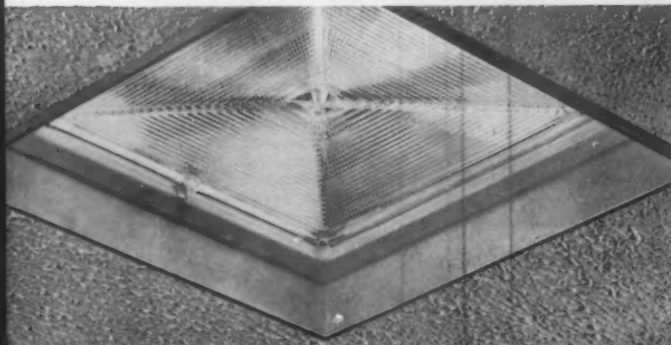
### choice of LENS

Diffusing Glass Bowl of  
Double-Tuf® ceramic-coated PYREX®  
Prismatically-accurate Flat Lens  
of fully tempered PYREX®

\*Reg. Trade Mark of Corning Glass Works

12" white UNI-FRAME with prismatic flat lens and splay.

10" brass finish UNI-FRAME with diffusing glass bowl and splay.





Northshore Shopping Center, Peabody, Mass., just north of Boston, is one of the largest suburban shopping areas. 10,000 KVA power requirement.



## "Putting in BERMICO CONDUIT was the easiest part of the job"

AL KENWORTHY,  
Electrical Contractor, Everett, Mass.

"When I saw the area to be wired, I expected the worst," reports Mr. Kenworthy, President of Kenworthy & Taylor. "It was craggy, rooted, and uneven."

"Luckily, Bermico was the specified conduit. Bermico is lightweight. It's easy to work with . . . its fittings simplify every installation problem. Putting in Bermico Conduit was the easiest part of the job."

For fast, money-saving installations . . . use Bermico on all your jobs. Bermico is

made from cellulose fibre, impregnated with coal tar pitch. Each 8-foot length is precision engineered, with smooth inside bore to allow easy cable pull-through without abrasion. It has high dielectric strength. Bermico is long lasting, too . . . extremely resistant to acids, alkalies, heat, water and corrosion. Try it.

Distributed by WESTINGHOUSE Electric Supply Company and Agent Jobbers  
Offices in Principal Cities

Another Quality Product of

**BROWN**  **COMPANY**

General Sales Office: 150 Causeway Street, Dept. 15109, Boston 14, Mass.

Mills: Berlin, N. H.; Corvallis, Oregon

# 6 bonuses

## bonus NO. 1 . . . EXTREME QUIETNESS

Quiet transformer operation with low loss is a blessing and a real source of satisfaction to building owners, managers, top executives, employees and patrons. Therefore a superior low noise level is an extremely important reason why you should specify and/or install PTC transformers on all jobs.

Look at these PTC low noise levels as they compare with present and recommended NEMA specifications.

KVA Transformer Rating	Present NEMA	Precision Average Sound Level Standard Design	Precision Average Sound Level Special Design
9-30	50	40	34
37½-112½	55	42	38
125-167	60	44	42
200-300	62	48	46

To recognize the extreme quietness of PTC transformers it is best to compare them in decibel sound level ratings with those of typical sounds familiar to everyday life.

### FOR EXAMPLE:

60-70 decibels—the sound of one typewriter or average traffic sounds 100 ft. away.

50-60 decibels—the sound of a vacuum cleaner or moderate restaurant clatter.

40-50 decibels—the noise to be found in an average residence or in normal conversation.

30-40 decibels—low conversation in a residence in the evening.

## bonus NO. 2 . . . EFFICIENCY

Transformer losses cost money. Precision transformer cores <sup>1</sup> use the lowest loss steel available. Precision transformers are wound with low resistance copper wire and designed for the greatest possible operation economy. These features reduce losses and save dollars not once, but year after year.

## bonus NO. 3 . . . OVERLOAD CAPACITY

Precision transformers are designed with large open ducts <sup>2</sup> for efficient cooling and operate at lower temperatures than specified in national standards. Superior PTC insulation materials, varnishes and wire enamels actually permit operating temperatures in excess of these standards with no loss of life. These factors together with low losses give Precision transformers unequalled ability to handle overloads.

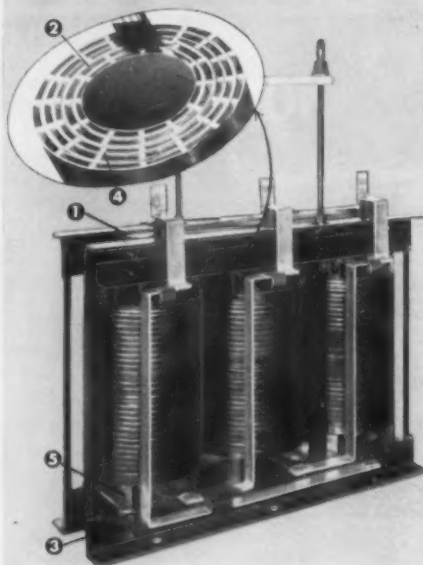
## bonus NO. 4 . . . DEPENDABILITY AND LONG LIFE

Dependability and long life can result only from ADVANCED DESIGN and BUILT-IN QUALITY. PTC transformers excel because they are constructed to meet the varying conditions under which they must be used. Additional PTC features are:

- Core laminations are clamped together with structural steel <sup>3</sup> rather than formed sheet steel for more rugged construction.
- Glass laminate duct spacers <sup>4</sup> used provide greater toughness, rigidity, dimensional stability, and moisture resistance far in excess of wood or paper phenolic laminate spacers.
- Coils are thoroughly clamped and braced around the core with fibre-glass laminate insulating blocks <sup>5</sup> resulting in greatest structural and tensile strength.
- Coils are made with an interlayer and interwinding insulation of Mylar-Quinterra and glass, assuring high dielectric strength, low moisture absorption and high temperature stability characteristics.

when you specify  
and/or install

# PTC

 TRANSFORMERS


## bonus NO. 5 . . . REDUCED INSTALLATION EXPENSE

Well designed and easily accessible mounting provisions together with ample connecting space and simple wiring termination mean neater installations at lower than normal cost.

## bonus NO. 6 . . . THE ONLY 5-YEAR UNCONDITIONAL GUARANTEE IN THE INDUSTRY

Your reputation as an electrical engineer or contractor depends upon YOUR ability to stand firmly behind your recommendations and installations.

It is reassuring to know that PTC transformers work because PTC people make them work—then stand unconditionally behind them.

### WHISPER-QUIET INSIDE-THE-WALL INSTALLATION

Precision Transformer Corporation has developed a unit which installs *inside-the-wall* in otherwise unusable space. Precision's "HUSH-FLUSH" design permits easy, full accessibility, lowest noise level close to load power service. Saves material and labor costs. Ideal for schools, libraries, hospitals, churches, theatres, etc.—wherever noise must be eliminated.

### Complete Line—DRY and LIQUID Types

Whatever your transformer needs, there is a dependable, quiet, long-lasting dry or liquid type transformer . . . more than 4,000 models ranging from ¼ to 5,000 KVA.

Write today for 4-page brochure providing details on the PTC line.

# PTC

TRANSFORMERS

- QUIET
- EFFICIENT
- DEPENDABLE

## PRECISION TRANSFORMER CORP.

2222 West Lake Street

Chicago 12, Illinois

Representatives in all principal cities



# Right off the

# Wire

69. Three years of testing in actual production have proved a new thermoplastic to be a successful substitute for non-ferrous metals in the die-casting of over 500 products including instrument housings, machine parts, plumbing fixtures and bearings.

70. Radar domes eighty-four feet in diameter that will withstand gale-force winds are being made of reinforced paper.

71. An engine that sprays a jet of water into the air is said to be applicable to boats of all sizes and to increase the speed of planing hulls by seventy-five per cent.

72. A two-unit antenna for a radio telescope (in which one unit reflects into the other) is being built at about one-tenth of the cost of a comparable dish-type antenna.

73. An inventor claims that his newly patented polarizing glass transmits eighty per cent of light and might solve the problem of polarized headlights.

74. A typewriter-size electronic computer is said to be able to make most of an engineer's routine calculations.

75. An all-metal tire for high-altitude aircraft is being tested. It is in the form of a circular wire brush and is said to have the same deflection characteristics as a pneumatic tire.

76. To use a new powdered paint the object to be coated is heated and dipped in the powder which melts and adheres in a film.

77. A new solution for photographic developing replaces three solutions now commonly used and is said to reduce development time to six minutes.

78. A unique television camera uses sound waves instead of light and can reveal the inner structure of materials or machines.

79. Drawings, pictures or writing can be transmitted by facsimile in scrambled, unintelligible form and reproduced as they were originally by a special receiver.

80. Sixty-five per cent of heat rays are reflected by a new plate-glass without serious loss of transparency. It is made by coating the surface with a film of metal sixteen millionths of an inch thick.

Further information on these news items and on Simplex cable is available from any Simplex office. Please be specific in your requests.

81. Any desired illumination level can be maintained with a new light control that automatically adds the right amount of artificial light to natural daylight.

82. Ordinary television sets may now be used in boats or automobiles by equipping them with a new transistorized inverter that converts 6 or 12-volt DC to 60-cycle, 115-volt DC.

83. The Navy's new radio telescope, to be built in West Virginia, will have a theoretical range of thirty-eight billion light years, nineteen times that of the two-hundred inch optical telescope on Palomar Mountain.

84. A pulse transformer to supply energy to underwater sonar transducers, can withstand a pressure of 15,000 pounds per square inch at 36,000 feet below sea level.

85. Plans have been made for a nuclear-powered blimp which could be in operation by 1963.

86. A pocket-size hi-fi tape recorder is battery operated, weighs only three pounds and can be carried in the pocket.

87. A new application of ultrasonics is a device that drives rats away with sounds inaudible to humans.

88. A solar generator is being used to charge an electric fence. It has a battery for use on dark days.



## \$40 Million Cable Laying Project Completed

Placement of the first deep-sea telephone cables linking the New World directly with continental Europe have been successfully completed by two cable-ships including HMTS Monarch, shown here at the Simplex Wire & Cable Co. docks at Newington, New Hampshire.

The new, 2,400-mile twin-cable transatlantic system, recently placed in public service, will provide thirty-six voice circuits between the U. S. and continental Europe.

All cable for the American-made segment of the system was manufactured by Simplex.

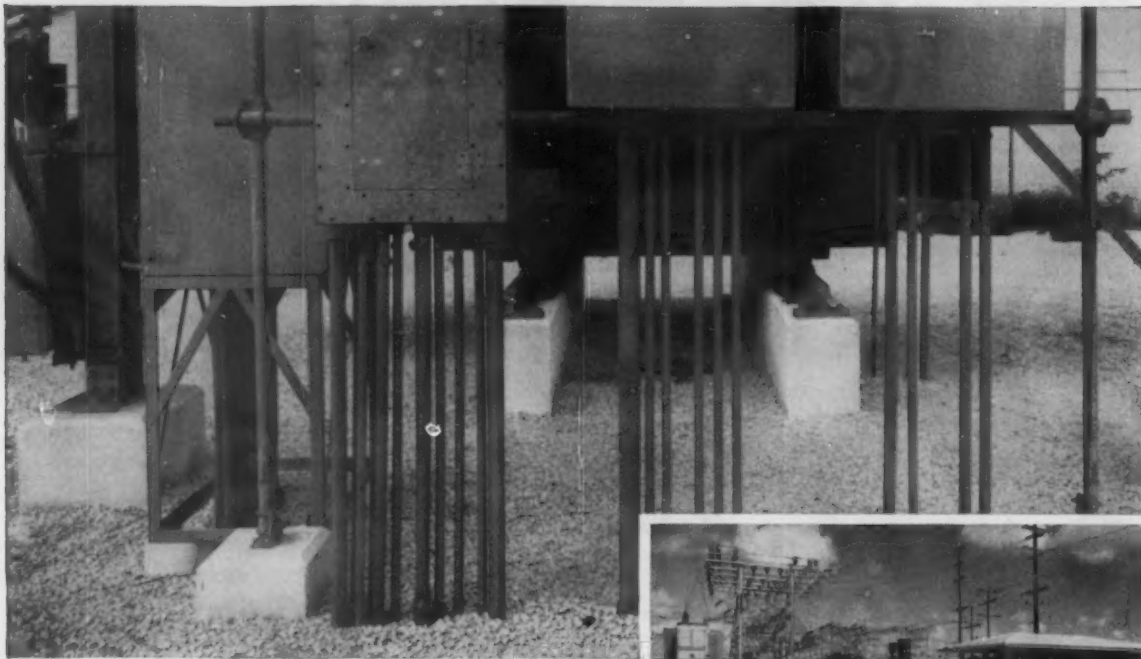
**SIMPLEX WIRE & CABLE CO.**  
Cambridge, Massachusetts and  
Newington, New Hampshire

# Simplex

Highest quality cables for: Mining  
Power & Lighting • Construction  
Transportation • Communications  
Signalling

News about

# B.F. Goodrich Chemical raw materials



Inset photo shows Biscayne Substation of Florida Power & Light Company where pipe-conduit made from Geon is used, as shown in large photo. B.F. Goodrich Chemical Company supplies the Geon polyvinyl material for many pipe manufacturers.

*At 125 substations . . .*

## **FP & L plans for future . . . uses conduit of Geon**

Florida's rapidly expanding economy has called for fast, sure growth on the part of Florida Power & Light Company. At 125 distribution substations located throughout the state, FP&L has installed conduit made of Geon rigid vinyl—as much as 3,000 feet at some locations.

Conduit of Geon rigid vinyl is lightweight and economical to install—and promises satisfactory service far longer than ordinary conduit because it is unaffected by most causes of corrosion. Internal and external surfaces stay smooth—like new through the years.

Geon resists the corrosive effects of salt water, gases, chemicals, and acid or alkaline soils. It also resists sunlight, fungi, bacteria, moisture, heat and cold. It offers high tensile or impact strength and is not affected by galvanic corrosion.

Engineers are finding new and cost-saving uses for pipe and conduit made of Geon in many applications, both above ground and underground. For information, write Dept. AU-4, B.F. Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.



**B.F. Goodrich Chemical Company**  
a division of The B.F. Goodrich Company



GEON polyvinyl materials • HYCAR rubber and latex • GOOD-RITE chemicals and plasticizers

**BELL DELUXE**  
**WEATHERPROOF**  
**Wiring Devices**



**NEW!** *Saf-T-Lok<sup>®</sup> CONSTRUCTION*  
***Snaps Open! Stays Open! Snaps Shut!***

**AMERICA'S LARGEST LINE OF WEATHERPROOF  
DEVICES and COVERS!**

**Write For Detailed Catalog**

**See us in Booth 233 N.E.C.A. Convention**



**BELL ELECTRIC COMPANY, 5735 S. CLAREMONT AVE., CHICAGO 36, ILL.**

TEST VALVE

GENERAL ELECTRIC

# JOB FINISHED... TIME SAVED

## with General Electric's NEW Integral Distribution Center

An electrician can install General Electric's new Integral Distribution Center in only four hours—faster and easier than other types.

This remarkable savings in time is made possible by:

**ONE-PIECE CONSTRUCTION**—Unit ships in one piece; eliminates need for assembling separate components at point of installation.

**SMALL SIZE**—Low height (only 79 inches) and up to three feet shorter in length allow new G-E Integral Distribution Centers to be moved through normal-size doors by means of a fork truck. Unit weighs up to 23 percent less than old designs and can be rolled or skidded in any direction for easy positioning.

**EASY TO CONNECT**—All lines can be brought in through

either top or bottom, and all connections can be made from the front of the unit. All units are furnished with solderless connectors for incoming and outgoing lines.

Why not use the distribution center that gives you "balanced design"? It installs and connects easier, faster. And gives your customers an *ideal balance* of quiet operation (G-E QHT\* transformers are up to 16 decibels below NEMA sound standards); compact, space-saving design (units require up to 30 percent less floor space); and safe, reliable operation (Type H insulation in units up to 5000 volts; Class B insulation in units above 5000).

**WANT MORE INFORMATION?** Fill in the coupon at right or contact your nearby General Electric Apparatus Distributor.

\* Quiet High-Temperature dry-type transformers.

Be sure to see G.E.'s new ID Center at the NECA Show, Booths 38-47.



## One-piece construction simplifies ordering, installation and connection

**ELECTRICIAN** Don Shoner found G.E.'s new Integral Distribution Center simple, fast to connect, using only the tools normally found in any electrician's work cart. Don completed installation of the 225-kva, 240-volt unit in only four hours.



**9:01 A.M.**—Unit in place and front panels being removed. High- and low-voltage compartments are immediately accessible on the new G-E unit.



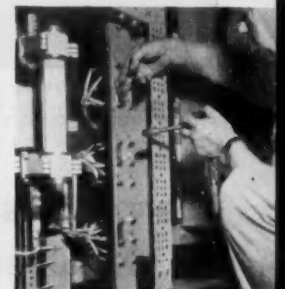
**9:31 A.M.**—Outgoing leads are connected to breaker panel. Quick-connect terminals require no soldering or taping.



**10:31 A.M.**—Fuses and fuse panel are removed in minutes allowing the electrician quick, easy access to the incoming connectors.



**10:45 A.M.**—Incoming lines are easily connected; do not require taping or soldering. Fuses and fuse panel are replaced easily.



**11:15 A.M.**—Transformer taps are changed to match incoming voltage. And then the panels are replaced.

# GENERAL ELECTRIC



SEND FOR THIS BULLETIN giving the full story on G-E Integral Distribution Centers.

**SECTION A411-10**  
General Electric Co.  
Schenectady 5, N. Y.

Please send me GEA-6928, "General Electric New Type H Integral Distribution Centers."

NAME \_\_\_\_\_  
TITLE \_\_\_\_\_  
COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
CITY \_\_\_\_\_ ZONE \_\_\_\_\_ STATE \_\_\_\_\_



*Revere Outdoor Lighting makes driving and parking safe and easy at Eastpoint Shopping Center, Baltimore, Md. The well lighted parking lot makes the shopping center look more inviting. Architect:*

*Kenneth C. Miller; Consulting Mechanical Electrical Engineers: Whitman, Requardt & Associates; Electrical Contractor: Harry A. Goldberg Co.; Electric Wholesaler: Graybar Electric Co., Inc.*

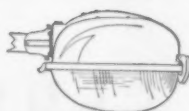
## Revere's complete line of matched equipment makes any outdoor lighting job easier

Any outdoor lighting problem is easier to solve with Revere equipment. The wide line, from one source, lets you select the exact combination of fixtures required to do the job best . . . simplifies ordering and assures on-schedule delivery, too.

At Eastpoint Shopping Center (above), Revere Endoval Mercury Luminaires, mounted on Revere hinged poles, illuminate driving lanes. Parking area lighting is provided by Revere floodlights with 400-watt EH-1 mercury lamps. Floodlights are mounted two or three to a Revere hinged pole, with pole spacing 150 ft. Ballasts are in manholes between poles. Average maintained footcandles 1.1.

Installation of equipment at Eastpoint was easier because Revere components are *matched* for strength, balance, and perfect fit . . . and for peak lighting efficiency. Write for a Revere outdoor lighting equipment catalog. The complete, matched line makes solving any outdoor lighting problem easier.

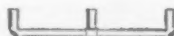
### Revere components used to light shopping center



No. 2222 Endoval Mercury Luminaires



No. 3351 Floodlights



No. 217-P Brackets



No. 199-J Brackets

No. 800 Series (most arm not shown) and No. 199-D-30 Hinged Poles



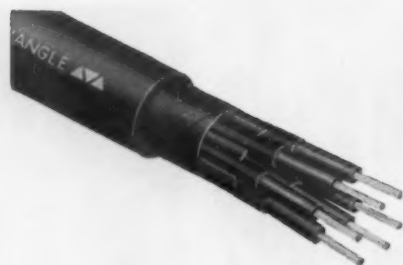
**Revere**  
ELECTRIC MFG. CO.

## OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)  
Long Distance Phone: Niles 7-6060 • Chicago Phone: Spring 4-1200 • Telegrams: WUX Niles

In Canada: Curtis Lighting, Ltd., Leaside, Toronto, Ontario

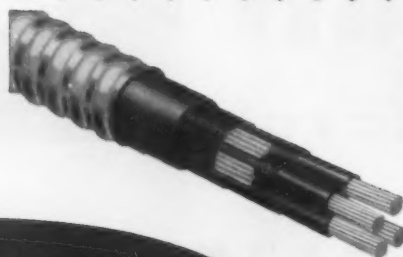




1



2



3



4

HOW MANY OF THESE  
CABLES CAN YOU NAME?



5



6

These six are only a few of the many types in the Triangle line of Power, Lighting and Control Cables. How many can you name without peeking at the bottom of the page?

You've probably worked with or specified every one of these types many times — more and more contractors and engineers are doing that these days. They've worked with Triangle Conduit and Building Wire products for years. And they've now become convinced that Triangle can turn out power cables to the same high quality standards. They know Triangle products "must be right"—they must be dependable long-time performers.

Why don't you find out more about these and other cables in the broad Triangle line. Write for complete literature which is available to answer your specific inquiry.

Buy Right—Buy From Your Distributor

**TRIANGLE CONDUIT & CABLE CO., INC.**  
NEW BRUNSWICK, NEW JERSEY

"It MUST Be Right!"

1 Control Cable 2 Varnished Cambric Lead Covered Power Cable 3 Interlocked Armor Power Cable 4 RH Cable 5 Asbestos Varnished Cambric Power Cable 6 UF Cable



# Is your plant next?



If you've ever thought that this couldn't happen to your plant, a few facts may quickly change your mind. It can and *does* happen to 305 industrial plants every day! Staggering? — so are the losses, \$52,260,000 worth every year.

But your plant needn't be chalked up as just another statistic! You can do something about it!

First, let's consider the cause of such large loss fires. It's a known fact that one of the main reasons small fires become blazing infernos is — *the delay in reporting the discovery of a fire or immediate notification to the local fire department.* The chart below is a grim, factual reminder of

What happens when an alarm is delayed\*

Property	Minutes Delayed	Reason for Delay	Loss
Creamery	1	Could not find alarm box	\$75,000
Woodworking plant	1	Discovered by passerby	\$101,000
Wire & cable plant	1	Employee tried to extinguish	\$395,000
Ore refinery	1	Employee tried to extinguish	\$250,000
Lumber yard	1	Employee tried to extinguish	\$150,000
Rubber plant	1	Fire destroyed telephone	\$100,000
Rubber warehouse	1	Telephone alarm, wrong address given	\$55,000
Matchworking plant	1	No alarm system	\$245,000

\*Includes loss of buildings, material and equipment, but not loss of business records and other intangibles.

## What you can do

Provide your plant with *complete* protection with a Gamewell FLEX-ALARM system that *identifies* the *zone location* of the fire, and one that can be *directly connected* with the *Municipal Fire Department.*

A FLEXALARM system can be pre-engineered to meet the precise needs of your plant. FLEXALARM is available as a coded or non-coded system, semi or completely automatic, with practically limitless possible combinations of annunciators, special drill, test and alarm features. For example, it can be tied into the

municipal alarm system at the curb; integrated with the sprinkler system; or automatic fire detection devices. It's simple to specify, easy to install, efficient and economical.

Specify Gamewell . . . for maximum protection at minimum cost. Write THE GAMEWELL COMPANY, 1295 Chestnut St., Newton Upper Falls 64, Massachusetts.

\*Facts on chart, itemized by The Gamewell Company, were taken from an article entitled "The Easiest Help Your Competitor Ever Got," in the May-June, 1959, issue of MODERN PLANT AND OPERATION MAINTENANCE. Reprints of this article may be obtained by filling out the coupon.

**Gamewell®**  
FIRST...WHEN SECONDS COUNT

### THE GAMEWELL COMPANY

1311 Chestnut St.

Newton Upper Falls 64, Mass.

- ☐ Have a Gamewell Fire Protection Engineer Call.
- ☐ Send me a Gamewell Fire Alarm System Planning Guide.
- ☐ Send a reprint of article "The Easiest Help Your Competitor Ever Got."

Name.....

Title.....

Firm.....

City.....Zone.....State.....

from *Smithcraft* imagination in lighting

SAVE TIME—SAVE COSTS!  
SPEEDOMATIC'S WONDER HANGER!

new

# Smithcraft

## SPEEDOMATIC TROFFERS



New Smithcraft Speedomatic troffers are packed with features that save hours and dollars for you! Wonder hangers and double-fast screws. Installs in seconds from below with screwdriver. Built-in dimensioning gauge. Telescopic door frame assures perfect fit, even in irregular ceiling openings. Large wiring access door. Only  $4\frac{1}{4}$ " deep, plenty of room for utilities. Large wireway end openings. Safety-locking door frame hinges. Four basic types fit over 100 ceiling systems. Packed two to a carton, with or without door frame installed. Compare the contractor-minded Smithcraft Speedomatic and see for yourself why Speedomatic is today's fastest-installing troffer.

**Smithcraft**  
LIGHTING  
CHELSEA 50, MASSACHUSETTS

Write today for a complete 30-page  
Speedomatic catalog  
and price list.

FREE! The Smithcraft Lightster  
measures your customers' and prospects'  
lighting in minutes. A valuable sales aid  
for you! Send for a free sample now.



+ Light-conditioning by *Smithcraft*—America's finest fluorescent lighting

# GET THE BIG 3

IN COMPRESSION-CONNECTOR TOOLING



**Y10M**

Light-weight hand tool installs a wide variety of HYDENT® connectors on wire sizes #22 thru #10. A wire cutter and single indenter die for all wire sizes are in the nose of the tool. Other features are wire stripper, bolt cutter, thread chasers, and dies for closing insulation-grips.

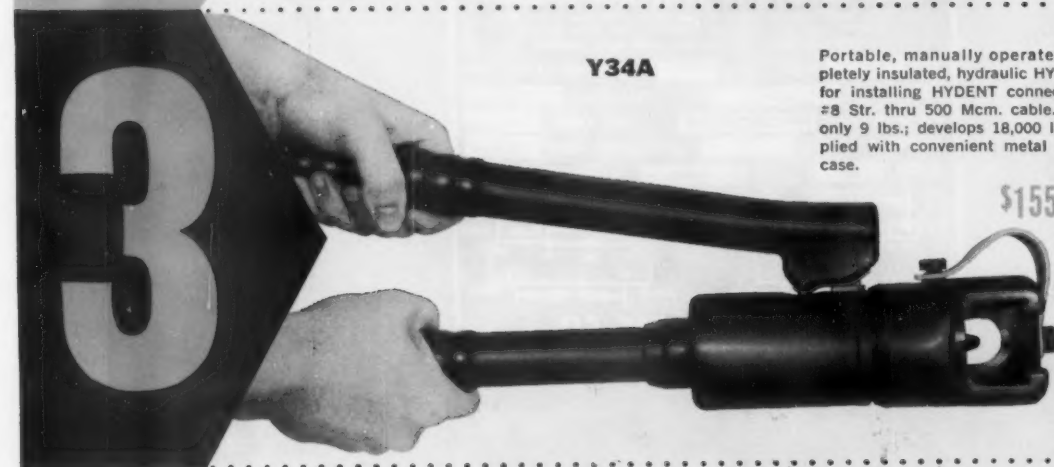
**\$3.95<sup>ea</sup>**



**MY29-3**

This HYTOOL® features one easily adjusted die set that installs HYDENT on commercial copper cable from #8 to 250 Mcm. and on aluminum conductors #8 to 4/0. Indexing plates are used for setting adjustable nest die for either copper or aluminum. No dies to install, change, identify or lose.

**\$36.00<sup>ea</sup>**



**Y34A**

Portable, manually operated, completely insulated, hydraulic HYPRESS® for installing HYDENT connectors on #8 Str. thru 500 Mcm. cable. Weighs only 9 lbs.; develops 18,000 lbs. Supplied with convenient metal carrying case.

**\$155.00<sup>ea</sup>**

Contractors with an eye on cutting connector installation time count on the Burndy Big 3. This Y10M, MY29-3, Y34A combination crimps practically every type and size compression connector on any job...adds the versatility, speed, and economy that result in profitable jobs. See your local Burndy distributor for demonstration.

# BURNDY

Norwalk, Connect.

In Europe: Antwerp, Belgium

Toronto, Canada



**SOLA CONSTANT WATTAGE BALLAST**  
 MADE UNDER ONE OR MORE OF THE FOLLOWING SOLA PATENT NOS.  
 U.S. PATS. 2,551,291; 2,505,199; 2,340,821 AND PAT'S PENDING  
 CANADIAN PAT'S 439,590 (1947) AND PAT'S PENDING

FOR 400 WATT TYPE H33-1 MERCURY VAPOR LAMP  
 CATALOG NO. 77-10-202 SERIAL NO.             
 PRI. OPER. VOLTS 100-130X200-266 PRI. AMPS             
 SECONDARY OCV            SECONDARY AMPS 3.2  
 CYCLES 60 HIGH POWER FACTOR TYPE           

**115V** **230V**

BLACK BLACK GREEN BLACK BLACK BLACK BLACK  
 H1 H2 H3 H4 H1 H2 H3 H4  
 WHITE WHITE WHITE WHITE

**SOLA ELECTRIC CO.**  
 CHICAGO 50 ILL. MADE IN U.S.A.

**Sola Catalog No. 77-10-202**  
 constant-wattage transformer  
 for two H1, H25 or H33-1  
 400-watt mercury lamps—  
 outdoor, weatherproof service



# NEW



## Sola outdoor mercury-lamp transformer is smallest, lightest two-lamp, constant-wattage unit

Reduced in weight from 70 to 48 pounds and in diameter from 8 $\frac{3}{8}$  to 6 $\frac{5}{8}$  inches, transformer Catalog No. 77-10-202 saves time, money and effort in shipping, handling, and installation. Improved operating characteristics result from a newly designed constant-wattage circuit combined with the use of Class-B insulation. Delivering ample open-circuit voltage for straight series operation of two 400-watt mercury lamps, the new model replaces series-sequence unit, Catalog No. 77046.

Performance improvements include a lower crest factor (peak/rms ratio) of lamp current. Reduction to a value of only 1.6 contributes to extended lamp

life as well as high lumen maintenance over the lamps' useful life. Less than  $\pm 1\%$  variation in rated lumen output — even with line voltage fluctuations as great as  $\pm 13\%$  — results from the new circuit's improved lamp-wattage regulation. The new two-lamp unit has an efficiency of 90%, with a transformer loss of only 80 watts.

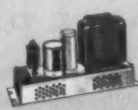
The housing is a single-piece, deep-drawn case . . . hot-dip galvanized and completely sealed. Special neoprene-covered leads are brought out through a neoprene plug in the threaded nipple. The new Sola mercury-lamp transformer is absolutely weatherproof and watertight.

**Full engineering details and performance data are available in new bulletin MVO-359. Write for your copy to the Manager, Lighting Sales.**

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill., Bishop 2-1414 • Offices in principal cities • In Canada, Sola Electric (Canada) Ltd., 24 Canmotor Ave., Toronto 18, Ont.



CONSTANT VOLTAGE TRANSFORMERS



REGULATED DC POWER SUPPLIES



MERCURY LAMP TRANSFORMERS

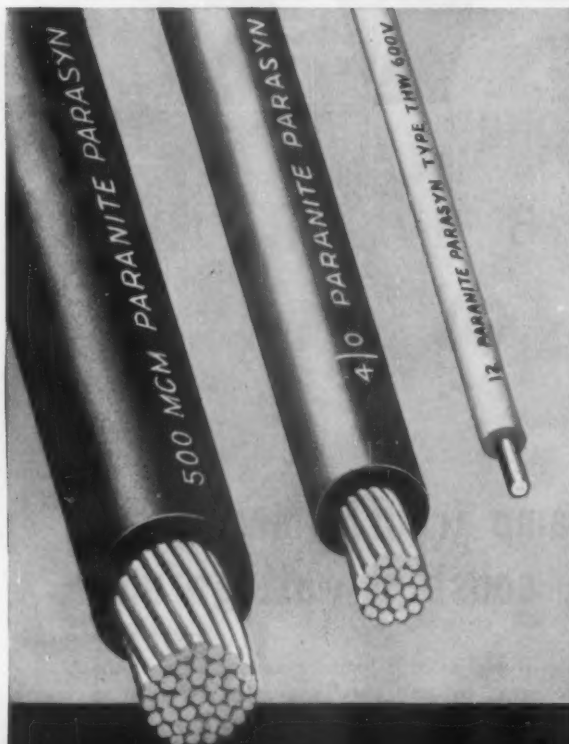


FLUORESCENT LAMP BALLASTS

A DIVISION OF BASIC PRODUCTS CORPORATION

# PARANITE THW and RHW

Two types available for 75°C wet or dry specified applications



NEW! PARASYN® TYPE  
**THW**  
THERMOPLASTIC INSULATED  
600 V BUILDING WIRE

New UL listed 75°C building wire for wet or dry applications. Specially formulated Paranite vinyl insulation. Small diameters, slick silicone finish, color availability and stripping ease all contribute to reducing handling costs!



MYLAR TAPED®  
PARATEMP® TYPE  
**RHW**  
600 V BUILDING WIRE

Taped with \* Dupont "Mylar" (AWG 6 and larger) to provide an improved moisture barrier with higher dielectric strength. Resulting diameter reductions, better fit conduit. Saturated and impregnated, braided sheath, lubricated with special waxes to reduce pulling resistance.

## Both UL listed 75°C wet or dry location

Here are two improved building wire products—both offering you outstanding performance in similar installations. Standard colors available from stock in both solid and stranded, sizes 14 AWG through 500 MCM for the THW . . . and 14 AWG through 1000 MCM for the RHW. Get acquainted with advantages of both wires—write today for complete technical information!

## PARANITE WIRE AND CABLE DIVISION

Essex Wire Corporation, Marion, Indiana

Sold only through recognized electrical distributors

MANUFACTURING PLANTS: Marion, Ind.; Jonesboro, Ind.; Tiffin, Ohio; Anaheim, Calif.

\* Sales Offices and Redistribution Warehouses in all Principal Cities



Each Carlon packaged to reduce handling and labor cost with "color-coded" labels plainly showing type, size and color of wire. Also, new reel cards for instant identification and inventory control.

# BOSS... COMPLETE LINE OF ELECTRICAL ENCLOSURES

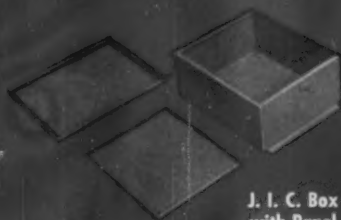


## BOSS J.I.C. Wireway and Fittings

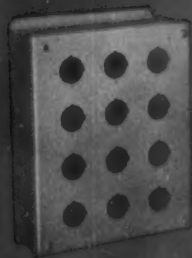
Flanged Hinged Cover Wireway & Fittings

Flangeless Screw Cover Wireway & Fittings

Flangeless Hinged Cover Lay-In Wireway & Fittings



J. I. C. Box  
with Panel



Oil Tight  
Pushbutton Enclosure

"The Line of Least Resistance"

# BOSS

You can always be sure of *excellent quality* and *prompt delivery* on stock or "specials" with the complete line of BOSS Boxes, Wireway and Fittings.

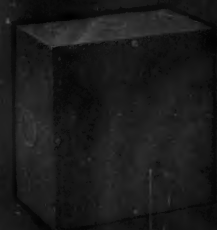
Job-engineered for quick, easy installations, BOSS enclosures are code gauge steel, have smooth corners, with firm but easy knockouts. All units are *UL approved*. Finished in durable gray baked enamel.

BOSS now also offers you new *Oil Tight Push Button Enclosures* for excellent protection against oil, dirt and liquids.

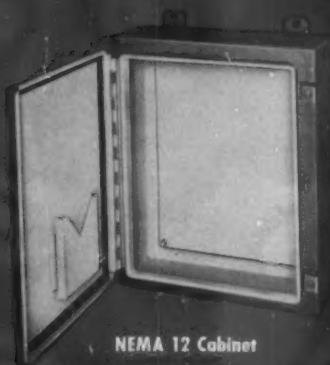
Write for Catalog on the complete line of BOSS Electrical Enclosures.

**Sold thru leading distributors everywhere.**

Type "A" Box



Screw Cover Pull Box



NEMA 12 Cabinet



Transformer  
Cabinet



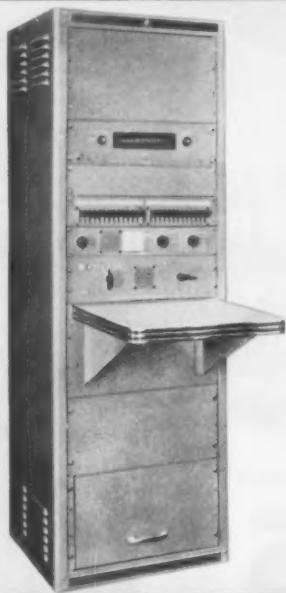
Telephone Cabinet

**You can rely on BOSS for custom fabrication of your "specials" of any type**

**THE HUENEFELD CO.** Engineered Products Division

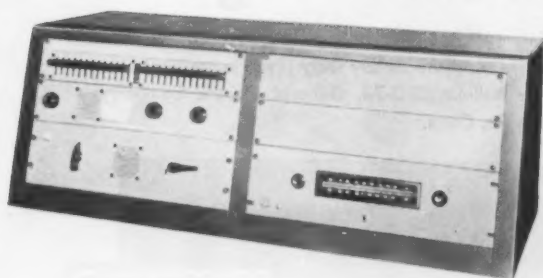
2701 SPRING GROVE AVE.

CINCINNATI 25, OHIO



**LOW PRICES  
MAKE  
ROOM FOR  
EXTRA  
PROFITS**





## with new **Made-to-Order RCA Sound Systems**

Now ready from RCA is a completely new line of sound control equipment which will improve your profit margins every time you make a sound system bid. With a Made-to-Order RCA Sound System, you can meet any set of specifications. And the low prices you pay for RCA equipment allow you plenty of room for more profit than you've made on sound systems before.

Use a Made-to-Order RCA Sound System on a contract with all the confidence in the world. You know its RCA quality will provide dependable performance, meeting every specified requirement, for years to come. You can work flexibly with a Made-to-Order RCA Sound System, too, for one can be planned around a rack cabinet, console, desk pedestal or desk-top unit.

Modular RCA Sound Systems are custom assembled from a wide selection of standard components to meet exact specifications. The systems are assembled at the RCA factory and are shipped with all units in place, with plug-in connections for quick inter-apparatus hook-

up. Before shipment, the individual components are tested and the entire system is checked out against rigid RCA performance standards.

A Made-to-Order RCA Sound System includes many other advantages in its low price. Its "building-block" design means easy, inexpensive installation and servicing. Also, it's simple to add RCA standardized components—always at low prices—whenever a system needs expanding.

Here are some ideas for action.

### **CALL YOUR RCA ENGINEERED SOUND DISTRIBUTOR**

He's the man to help you plan Made-to-Order Sound Systems at prices that beat the field. He's listed in your classified directory under "Public Address and Sound Systems."

### **OR . . . SEND THE COUPON FOR MORE INFORMATION**

Your "RCA Modular Sound System Select-A-Guide" goes in the mail as soon as we receive this coupon from you. The sooner the better . . . so we can help you make sound business your business!



Tmk(s) ®

**RADIO CORPORATION OF AMERICA**

SOUND PRODUCTS  
CAMDEN 2, NEW JERSEY

Radio Corporation of America  
Sound Products, Dept. Z-41  
Camden 2, New Jersey

Send my "RCA Modular Sound System Select-A-Guide" quickly, please.

Name

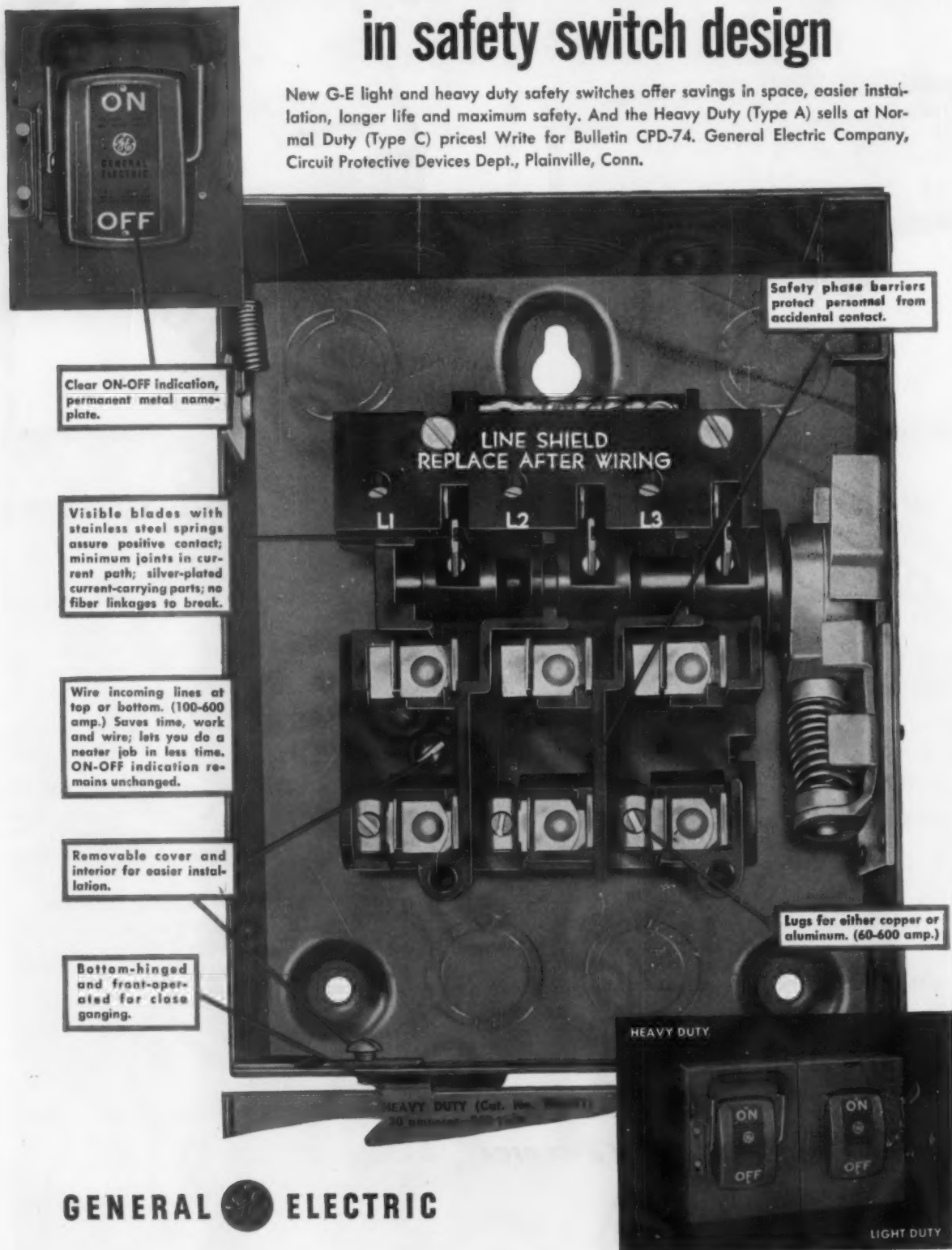
Firm

Address

City  Zone  State

# General Electric brings you bold new advances in safety switch design

New G-E light and heavy duty safety switches offer savings in space, easier installation, longer life and maximum safety. And the Heavy Duty (Type A) sells at Normal Duty (Type C) prices! Write for Bulletin CPD-74. General Electric Company, Circuit Protective Devices Dept., Plainville, Conn.



**GENERAL ELECTRIC**

# your control cable problems end here



## PLASTICOTE® INSULATED AND JACKETED CONTROL CABLE

Of all cable products, Control Cable has the greatest responsibility in safeguarding life and property . . . for on its unfailing function rests the immediate response to fire alarms, the constant operation of power station control circuits, the quick action of police and day-after-day traffic control. Chester's light weight, unusually pliable and highly resistant Plasticote insulated and jacketed Control Cable meets the strict Industry Standard specifications for all of these vital services. At the same time, Chester solves cost problems, too, with long life, trouble-free cable for direct earth burial, overhead and flexible lines in building installations. In many cases, physical and electrical properties exceed those of other types of insulation. Careful attention to all these needs, vital to service and installation, makes Chester Plasticote Control Cable a preferred brand for municipal services . . . for power station and supervisory circuits . . . for flexible or extension connections. Electrical men know that Chester cable is *custom engineered for the END result!*




**CHESTER CABLE CORP., CHESTER, NEW YORK**  
A SUBSIDIARY OF MIAMI COPPER COMPANY



Complete data on  
Chester Control Cable is  
available on request.  
Ask for Bulletin No. ECC-1

### *Specify Chester Wire and Cable For All Your Electrical Equipment Needs*

Control Cable • Bus Drop Cable • Service Cord • Safety Control Wire • Thermostat Cable • Underground Feeder Cable • Bell Wire • Machine Tool Wire • Armored Bushed Cable • Building Wire • TV Lead-in • Train Wire • Ignition Cable • Flexible Conduit • Bare Copper Wire • Service Entrance Cable • Mine Service Wire & Cable • Hook-up Wire • Telephone Wire



**LINE MATERIAL FLUORESCENTS** provide the lighting needed to attract customers to this shopping center, and to illuminate the parking area in front

of it. The installation consists of deep four-lamp units, which provide ample light for display and security.



**MOTEL OWNERS** recognize the value of controlled lighting that lights up the approaches and driveways without disturbing glare. This owner selected L-M Ovalite luminaires, which utilize 21,000-lumen mercury vapor lamps to provide high-level illumination.



**L-M FLOODLIGHT FLUORESCENTS** provide excellent light for night operations on this loading dock, since the low brightness of the units will not blind the workers. Each unit contains two 6-foot fluorescent lamps with a total output per luminaire of 11,400 lumens.



**THE NEW L-M PTL (Post Top Luminaire)** combines a decorative, elegant appearance with a highly efficient light distribution system. Specially suited for residential and institutional grounds, schools, parks and other areas where appearance is important, it replaces old inefficient luminaires at a relatively low cost. Available in brushed aluminum or pastel colors for incandescent or mercury vapor lamps with a choice of five IES light patterns.

#### SOME TYPICAL L-M LUMINAIRES



**LINE MATERIAL®**  
MCGRAW-EDISON COMPANY





SPECIALLY DESIGNED LUMINAIRES in Rhondda Valley Shopping Center, Sunnyvale, Calif. This installation and the special units were designed under the direction of L-M Lighting Engineer Bruce Kunde, in

cooperation with the designer, Robert M. Sherman, and Cupertino Electric Company, the electrical contractor. The units on each standard are L-M floodlight fluorescents, holding two 6-foot lamps.

## Streets, Shopping Centers, Airports ... You Name It ... L-M Will Light It!

Line Material, a pioneer and leader in outdoor lighting, provides incandescent, mercury vapor, fluorescent luminaires and related equipment for a wide variety of applications. Standard and special designs are available. L-M Lighting Application Engineers cooperate with utilities, municipalities, engineers, architects and contractors to help provide the most suitable, efficient, and economical equipment for each particular application.

The specially designed lighting unit in the Sunnyvale, Calif., shopping center shown above is an example of an unusual problem solved by one of L-M's Lighting Engineers, with the cooperation of L-M's engineering and manufacturing departments.

Fluorescent units include the Delta type and V-type, which give excellent street lighting; the 2-lamp floodlight, used for wall mounting on airport runways, loading docks, store fronts, etc. A wide variety of mercury vapor and incandescent units are used for highway intersection, toll road, access, neighborhood, and rural lighting.

**Bring Us Your Lighting Problem . . .** Whatever your outdoor lighting job may be, talk to the L-M Field Engineer or Lighting Engineer. You'll get suggestions, information, bulletins, and, if you wish, a complete lighting application engineering job. Or, if you prefer, write Lighting Division, Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Division of McGraw-Edison Company (Canada), Ltd., Toronto 13, Ontario.



For complete information and engineering assistance, phone or write any of these  
**SALES OFFICES**

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Dallas 7, Texas	1908 Hi-Line Drive	Raleigh, N.C.	216 Russ St.
Dayton, Ohio	9 Shady Lane	Richmond 21, Va.	4111 W. Clay St.
Denver 2, Colo.	5105 E. 39th Ave.	Roanoke, Va.	915 S. Jefferson St.
Des Moines, Iowa	201 Continental Bldg.	Sacramento 18, Calif.	1123 Tenebri Way
Detroit 2, Mich.	611 Stephenson Bldg.	St. Louis 1, Mo.	1024 Title Guaranty Bldg.
Duluth 4, Minn.	3331 E. Superior St.	Salt Lake City, Utah	900 S. 6th West St.
East Stroudsburg, Pa.	North Burton St.	San Antonio, Texas	825 Majestic Bldg.
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Houston, Texas	5715 Navigation Blvd.	Tampa 2, Florida	306 No. Hempert Ave.
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Jackson 6, Mich.	1514 Daniel Road	Union, N. J.	P. O. Box 306
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## Industries Outdoor Lighting



411

DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUPS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT  
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

# what you should know about TYPE

## CHARACTERISTICS OF TYPE MI

**1. Just what is MI?** Here's how the NEC describes MI (Article 330): "A cable in which one or more electrical conductors are insulated with a highly compressed refractory mineral insulation and enclosed in a liquid-tight and gas-tight metallic tube sheathing." The conductors and the sheath are electrolytic copper. The mineral insulation is magnesium oxide. MI IS UL APPROVED.

**2. What's so unusual about it?** Since it is of all-mineral construction—copper and inert magnesium oxide—it is not subject to normal destructive influences such as heat, moisture, sunlight, oils, etc.

**3. Is it flame-proof?** Absolutely. Magnesium oxide is non-flammable and will not support combustion.

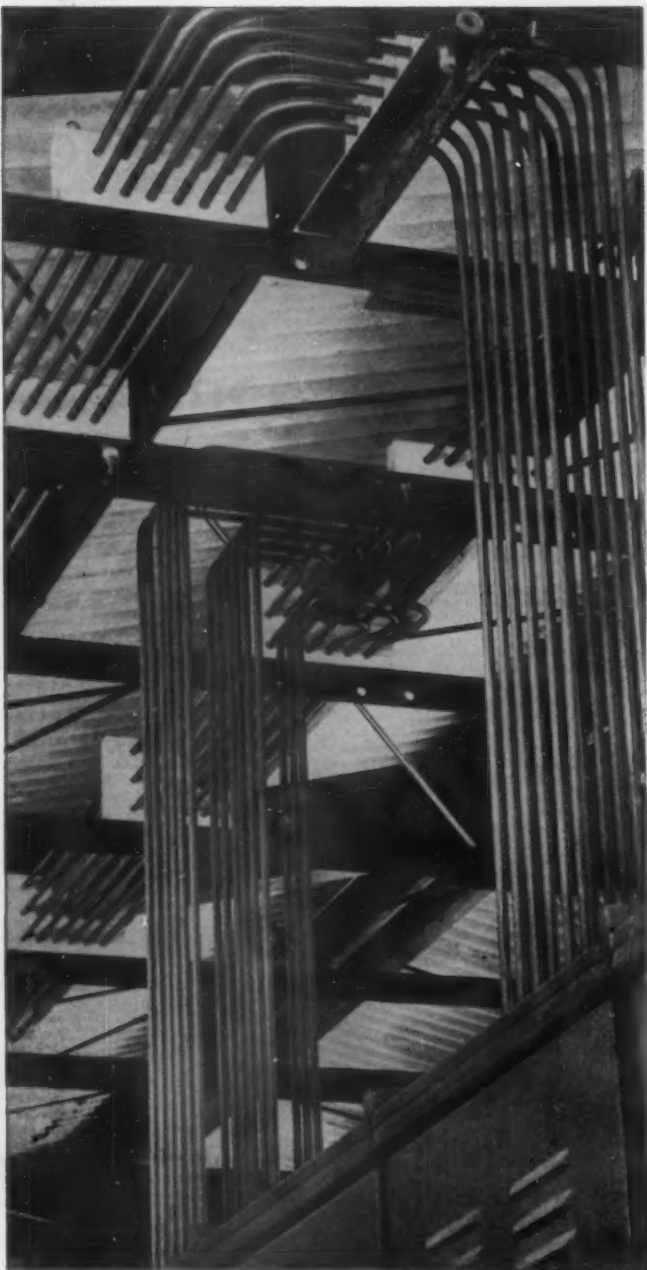
**4. What are its temperature limits?** MI may be operated continuously with ceramic terminating seals at temperatures as high as 250°C (482°F). For a "one-shot" application it may be operated at temperatures as high as the melting point of copper (1083°C). Routine Code applications which use standard terminating seals should be kept at 85°C (185°F) in the termination area.

**5. Is it moisture-proof?** Yes. The seamless copper sheath is impermeable to moisture. Properly applied end seals completely seal against moisture.

**6. Why is it electrically safer?** A grounded wiring system is safer than an ungrounded one. It is impossible to install MI properly without effectively grounding it.

**7. What is the current rating of MI?** For general use, the rating is determined by the standard end seals, which are rated at 85°C (185°F).

**8. What is the working voltage of the system?** The maximum working voltage is 600 volts AC or DC. Factory test voltage is 2500 volts.



# MI CABLE

## FOR 600-VOLT APPLICATIONS

**9. What's the normal life of an MI wiring installation?** MI will outlast the structure in which it is installed.

### WHERE MI IS USED

**10. Can MI be installed in industrial plants?** It is ideal for industrial installation, because it eliminates downtime and repair work due to cable failures. MI IS UL APPROVED FOR HAZARDOUS LOCATIONS.

**11. Is it useful in any type of industry?** It certainly is, particularly because of its resistance to heat, moisture, oils, chemicals and other harmful influences. Successful installations have been made in pulp mills, glass factories, printing plants, chemical plants, petroleum refineries, ships, coal mines, dairies, breweries, steel mills, and many others.

**12. Where else is MI used?** Because of its small space requirements (no conduit or duct is required), safety and neat appearance, it has been used in schools, museums, commercial buildings, hospitals, research laboratories, and in machine tool wiring.

### HOW MI IS INSTALLED

**13. Is it difficult to install?** No, it is very easy to install. All you have to do is cut it to length, train into position and secure it by standard clamps or straps to any surface. No conduit or duct is needed. It is easy to terminate and attach to standard boxes or equipment.

**14. Can it be used with other wiring systems?** Yes: MI is perfectly compatible with other wiring systems.

**15. Are special boxes or equipment attachments required with MI?** No. You can attach it to all standard electrical boxes, enclosures and equipment. Threaded MI cable fittings in the four standard

conduit group sizes and having standard conduit threads may be ordered with the cable.

**16. Do you need special tools?** Only two: a sheath stripper and an end seal crimping tool. Both are available from General Cable. Except for these, regular electricians' tools are all that are needed.

**17. Does MI bend easily?** You can bend it by hand in the smaller diameters. In larger sizes, a standard bending tool or "hickey" will do the job easily.

**18. Is special training needed to install it?** No. A qualified electrician can do it simply by referring to the instructions in the Instruction Manual included with each shipment.

**19. Where can fittings be obtained?** Fittings may be ordered with the cable in the quantity desired. They'll be delivered with the cable.

**20. How about delivery?** Most sizes are available from stock. The local General Cable office nearest you can give you full details.

Ask any General Cable Authorized Distributor or your General Cable Representative—at any one of the 65 General Cable offices coast-to-coast—to pinpoint actual installations of Type MI in plants comparable to your own. For a free copy of the new 12-page Type MI Catalog, just write Dept. EC-10,

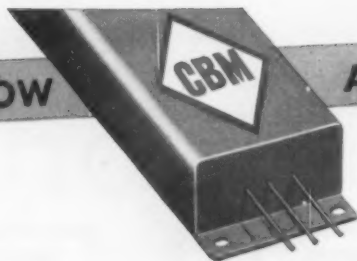
**GENERAL CABLE CORPORATION,**  
730 Third Avenue, New York 17, N. Y.  
Offices and Distributing Centers Coast-to-Coast



## GENERAL CABLE

*for quality and service... specify*

HOW



ASSURES YOU BETTER BALLAST VALUE

*ETL checks 12 to 14 specified ballast characteristics  
on all Certified types in production  
by each manufacturer, verifies compliance  
by test... and does it every month!*



to be  
marked CBM  
... It must  
measure  
up!

**S**PECIFIED performance is checked by test... that's why you can always rely on Certified CBM ballasts for dependable lighting service.

What characteristics are checked? The operating qualities which the American Standards Association has determined will give dependable, rated performance from the lamps with which the ballasts are designed to be used. These constitute the CBM Specification and assure:

- High power factor
- High light output
- Positive starting
- Rated lamp life
- Limit on heat rise
- Control for steady light
- Quiet operation

From these qualities come practical benefits: Up to 2,500 hours more lamp life than with ordinary ballasts; as much as 40% more light output; and savings

on installation... with less wire, fewer circuits needed for fixtures CBM equipped... fewer fixtures for the same level of light.

For the latest facts on why it pays to specify fixtures equipped with Certified CBM Ballasts, ask us to send you CBM NEWS.



**CERTIFIED  
BALLAST  
MANUFACTURERS**

2118 KEITH BUILDING  
CLEVELAND 15, OHIO

Participation in CBM is open to any manufacturer who wishes to qualify

2-59



# Easy to Select, Install, Maintain...

## **CROUSE/HINDS**

# FLOODLIGHTS

### Mercury Vapor Floodlights

The light output of mercury lamps is more than twice that of large incandescent lamps, and the rated life is seven times as long. The cost of mercury lamps is justified when important factors are long burning hours, labor costs or trouble of re-lamping. Constant-wattage-type ballasts regulate the lamp current so that light output remains constant even with large variations in line voltage.

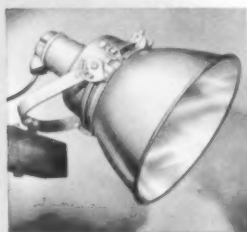
High-power-factor ballasts are generally preferred since the lower line current may allow a saving in the wiring cost. Crouse-Hinds broad Mercury Vapor line will meet virtually any floodlighting requirement.



Type MVE  
Heavy Duty  
Mercury Floodlight



Type MVB  
General Purpose  
Mercury Floodlight



Type MVF Floodlight



Type DCX-24

### Incandescent Searchlights

Crouse-Hinds searchlights in 8, 12, 18, 24 and 36-inch lens sizes and lamp sizes to 5000 watts are available with several different types of bases. Type DCE searchlights are generally used as fixed projectors for spotting distant objects; Type DCY are arranged for direct manual control; and Type DCX are furnished with lever control base for directing from below.



Type ADE-12



Type  
LCE-24

From major athletic fields to parking lots, from petroleum refineries to boxing rings, modern Crouse-Hinds Floodlights turn night into day. With a type and style floodlight to suit every need, Crouse-Hinds will help you put exactly the right amount of light in exactly the right places.

Our Lighting Engineers have unusually broad experience in Floodlighting. You can get their assistance by sending a drawing and description of the area you plan to light. We will then submit a complete lighting recommendation, with prices, for your consideration.

### Heavy Duty Floodlights

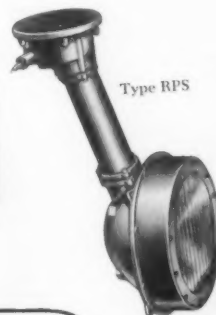
Constructed of cast aluminum alloy to withstand rough, rugged duty. They are highly efficient and are available in 12", 14", 16", 20" and 24" lens diameters, from 200W to 2000W lamp sizes. Reflectors and lenses can be varied to provide narrow or wide beams, diffused, concentrated or colored light — or any other combination needed.

### Floodlights for Underwater Use

Crouse-Hinds Underwater Floodlights are of the dry niche type. Both styles are available with or without tile masks. Type RPS can be relamped from pool edge.



Type SPS



Type RPS

**CROUSE HINDS**  
SYRACUSE NEW YORK

# CROUSE / HINDS

## TYPE FLA FLOODLIGHT

*Epecially suited to sportslighting*

Easier to install, aim, maintain, relamp. Higher efficiency. Permanently weathertight. Pre-wired. Corrosion-resistant. Heat-tempered lens. Available in five beam spreads. Non-tarnishing Alzak reflectors. These are some of the reasons why the FLA is the most popular Floodlight available anywhere. Type FLA has found special favor in sportslighting. Gives more light at lower cost with less maintenance for a longer period. You name the sport and FLA will light it . . . better. Lamp sizes 750W to 1500W. Ask for Sports-lighting bulletin 2605.



Type FLA

## General Purpose Floodlights

Available in an amazing variety of sizes, types and prices. There are simple porcelain-enameled open styles, low-cost sheet aluminum styles, lightweight weather-proof hinged-door styles . . . and so on. Get exactly what you want from the many types of reflectors, mountings, lenses and beam spreads offered.



Type MUA Alumalux  
(750W-1500W)

Type MDB-14  
(500W)



Type MDB-10  
(300W)



Type MUA Elliptalux  
(750W-1500W)

## For Modern Service Station Lighting

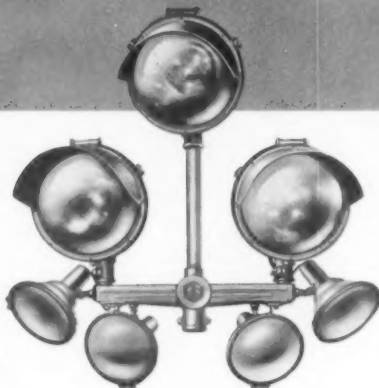
Crouse-Hinds offers several floodlights especially designed for service station use. No matter what the lighting problem — driveways, signs or buildings — you'll find Crouse-Hinds equipment to do the job.

Write for details, plus lighting diagrams.

Type SFL  
Sign Lighting  
Floodlight



Type MDA-14  
Service Station  
Floodlight  
(500W)



A typical installation of  
MDA-14 and MDB-10 Floodlights  
on a GPT Crossarm



Type RCDE-6  
Explosion-Proof  
Portable Floodlight.  
Also available for  
permanent  
installation  
(RCDE-6). 300W.

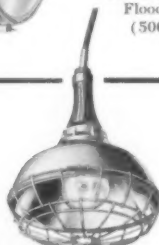


Type RLEE  
Explosion-Proof  
Floodlight. For  
heavier-duty  
applications.  
500W.

Type ADR Portable  
Floodlight.  
Especially adapted  
to emergency  
portable use.  
250W to 1000W.



Type MDS High  
Bay Lighting Fixture  
for Incandescent or  
Mercury Lamps.  
500W to 1500W



Type DIV  
Portable  
Underwater  
Floodlight.  
100W - 250W.

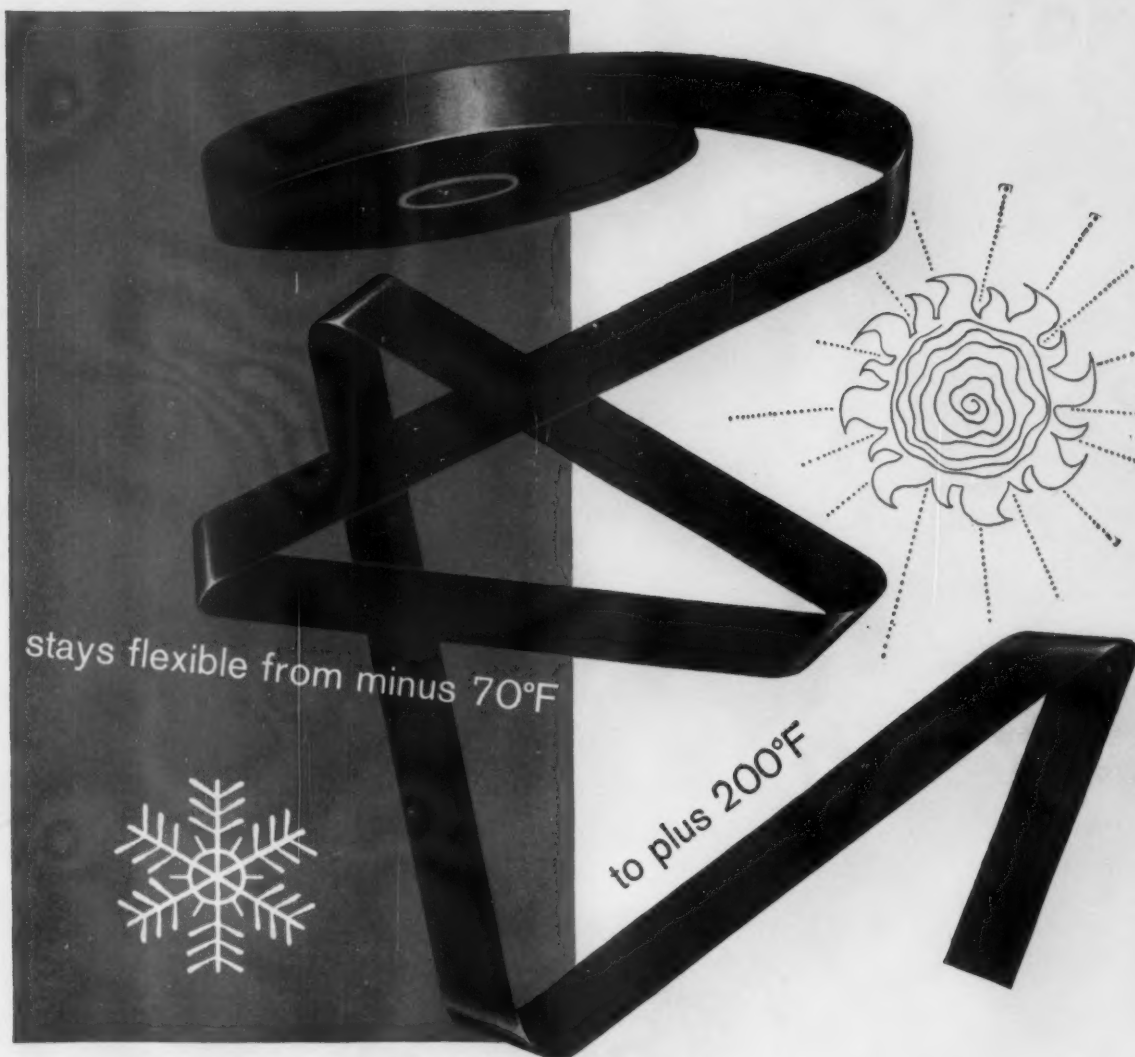
## Literature Available

Write for a copy of  
our Bulletin 2714,  
describing the  
complete line of  
Crouse-Hinds  
Floodlights.



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SYRACUSE NEW YORK

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## Porter® QUIK-STIK POLYETHYLENE ELECTRICAL TAPE

- Ideal for all outdoor and indoor, underground or overhead wiring, in utilities, electronics, aircraft, automotive, and general use.
- One-wrap, single-wind primary insulation.
- Permanent strong tack . . . fast-sticking anywhere!
- Dielectric strength tested to 1,000 volts per mil; uniform power factor over wide frequency range.

- Low moisture-permeability, high abrasion- and corona-resistance.
- Resists acids, alkalies, oils, solvents, fungus, bacteria, gases.

Get full information on Porter Quik-Stik polyethylene tape by writing today to *Thermoid Division, H. K. Porter Company, Inc., Tacony & Comly Sts., Philadelphia 24, Pa.*

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**PORTER SERVES INDUSTRY:** with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepocoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD





# THIS IS CORONA EFFECT

SPECTACULAR—

BUT IT'S ONE OF HIGH-VOLTAGE CABLE'S WORST ENEMIES

Corona means crown. It can also mean trouble for ordinary high-voltage cable—because corona is also the name for a low-energy electrical discharge (the glow around the crown at left) which actually cracks and splits ordinary rubber insulation. How? By ionizing any air in between and around conductor and insulation, it creates ozone, ultraviolet light, and certain nitrogen compounds.

And ozone, for example, works itself into ordinary rubber insulation and splits the long-chain rubber molecules. In time you see the costly result—cracked insulation and cable failure.

## HERE'S ANACONDA'S ANSWER

Butyl—the most effective rubber insulating material ever developed—has inherent resistance to ozone. And—to aging, moisture, and heat.

But—butyl handles differently from other rubbers. Additives, usually in the

form of finely divided powders, are extremely difficult to disperse uniformly in the raw butyl. Butyl also presents special vulcanizing problems. In short, proper manufacture of butyl insulation requires specialists and specialized equipment at every manufacturing step.

That's why Anaconda built a new plant for just one product—Anaconda Butyl (AB) Cable. The men behind this specialized equipment have but one job too—to study and improve the design and manufacture of butyl-insulated high-voltage cable.

This specialized manufacture and specialized inspection, test and quality control are part of the reason why Anaconda Butyl (AB) Cable means long-range economy and reliability, and why you should specify (AB) to protect your investment in high-voltage cable.

Send for publication DM 5903: High-Voltage Durasheath\* Cable to Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.

\*Reg. U.S. Pat. Off. 50257

ASK THE MAN FROM

# ANACONDA<sup>®</sup>

ABOUT BUTYL (AB) HIGH-VOLTAGE CABLE

# Count, sort, or inspect them faster

**Self-contained relay**



Low-cost; ideal for limit-switch-type application; includes a SP-DT output relay.

**Transistorized relay**



Features transistors; hermetically sealed plug-in relay; miniature light source, photocell holders.

**General-purpose relay**



A low-cost, highly reliable relay suited to counting, diverting, limiting and signalling jobs.

**Explosion-proof relay**



Watertight, explosion-proof; includes 3-inch lens, self-contained phototube, time delay.

**Long-distance relay**



Responsive only to light from accompanying light source; operates at distances up to 2,500 feet.

**Smoke-density indicator**



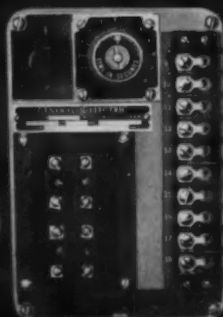
Measures smoke density, liquid turbidity, etc., and provides alarm when pre-set point is reached.

**Voltage-sensitive relay**



Detects voltage changes for meter operation, elevator-motor overspeed detection.

**Electronic timer**



Provides time delay of given duration, or set interval simply by setting dial at desired time.

**Cut-off register control**



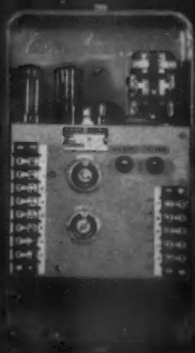
Low-cost; features direct operation of solenoid, small scanner, timed reset and relay kits.

# and more efficiently with modern

## G-E electronic devices

Your General Electric distributor offers a full line of simple, easy-to-use controls

High-speed relay



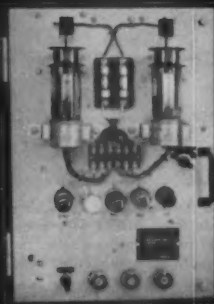
High-sensitivity; fast operating (600 ops. per min.); time delay, interlock, many other features.

Resistance-sensitive relay



Uses resistance changes to control a circuit; can operate motor to maintain liquid between two levels.

Side-register control



Accurately maintains lateral position of moving web in a process or machine; high-accuracy control.

Whether you're automating a production line . . . replacing obsolete machines . . . or, trying to get more out of present equipment . . . one of General Electric's photoelectric or electronic controls may help you gain faster, more efficient production.

Why? Because G-E photoelectric and electronic control devices are specifically intended to take the complexity . . . the labor . . . and the waste out of modern-day production. Combinations of these devices are applicable to virtually any industrial counting, sorting, signalling, protecting, diverting, detecting, or limiting job. And, chances are they will do the job at less initial cost—and lower operating cost—than the control methods you are now using.

### CONSIDER THESE EXTRA-VALUE FEATURES

Bonus features you get with job-proved General Electric photoelectric and electronic controls include:

**Fast response**—Relays operate on light changes as short as 1/1000th of a second.

**Versatility**—G-E relays operate on light increase, decrease, time delay, reflected light, slow or rapid light change.

**Dependability**—Lamps operate 3,000 hours or more. Components are conservatively rated for long, maintenance-free life.

If you are not satisfied with the efficiency of your production operations, it will pay you to find out about G.E.'s complete line of control devices. Call your nearby G-E Apparatus Sales Engineer or Distributor. Or, send us the coupon below. *General Electric Co., Specialty Control Dept., Waynesboro, Va.*

*Progress Is Our Most Important Product*

# GENERAL ELECTRIC

### SEND TODAY FOR **FREE** CATALOG

General Electric Co., Section F793-1  
Schenectady 5, N.Y.

Please send me a copy of the new G-E Photoelectric Control catalog, GEA-6822, with description, specifications, and pricing data on the complete line.

Name

Company

Address

City  State

*In concrete installations*

# Republic ELECTRUNITE E.M.T.

*...again proves*



**TYING**

...tying Republic ELECTRUNITE E.M.T. to the reinforcing bars is good installation practice.



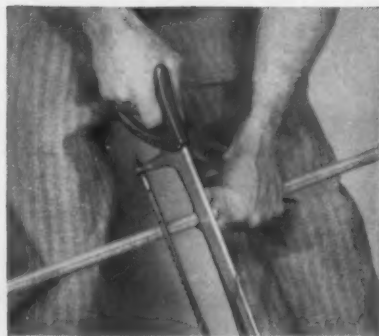
## THE BEST

The Republic ELECTRUNITE E.M.T. installation photos, above, were taken during the construction of this attractive six-story resident students apartment building on the campus of a leading Midwest university.

Architect: Burnham & Hammond, Chicago, Illinois

General Contractor: B. W. Handler Construction Co., Chicago, Illinois

Electrical Contractor: Gibson Electric Company, Inc., Chicago, Illinois



**EXCLUSIVE "INCH-MARKS"** make quick measurement a cinch. Every length of Republic ELECTRUNITE E.M.T. is marked off in feet and inches from end to end. Eliminates guesswork, saves time, saves material, keeps the job on schedule.



**"GUIDE-LINE"** extends full length of tubing. By properly aligning with calibrations on Republic Bending Tool, bends are kept in the correct plane. It is easy to make true offsets, saddles, back-to-back bends to meet the job.



New, Improved **"INSIDE-KNURLING"** with exclusive **SILVERSLICK** inside finish makes wire pulling up to 37% easier. Wire pushing is easier, too. Wires slip through longer runs and greater bends easier than ever before.





**STUB ALIGNMENT**

... "INCH-MARKS" and "GUIDE-LINES" help make neat, compact stub groupings.



**POURING**

... fittings fit ... ELECTRUNITE E.M.T. quality helps you stay ahead of the pour.

# COSTS LESS INSTALLED

In concrete installations... quality materials, craftsmanship, and good installation practices assure a good job. Republic ELECTRUNITE® E.M.T. with exclusive "INCH-MARKS", full length "GUIDE-LINES", and new, improved "INSIDE-KNURLING" with SILVERSLICK inside finish are three good reasons that prove . . . the best costs less installed! Here's why:

ELECTRUNITE's tightly adhering galvanized coating protects against corrosion. It won't chip or flake off during bending. No threading is required. Uniform concen-

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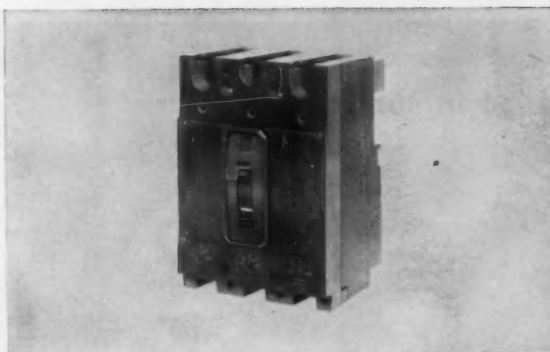
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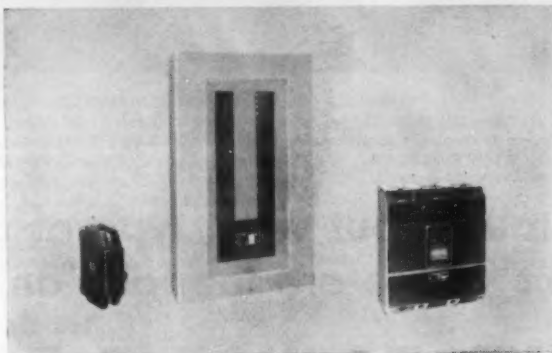
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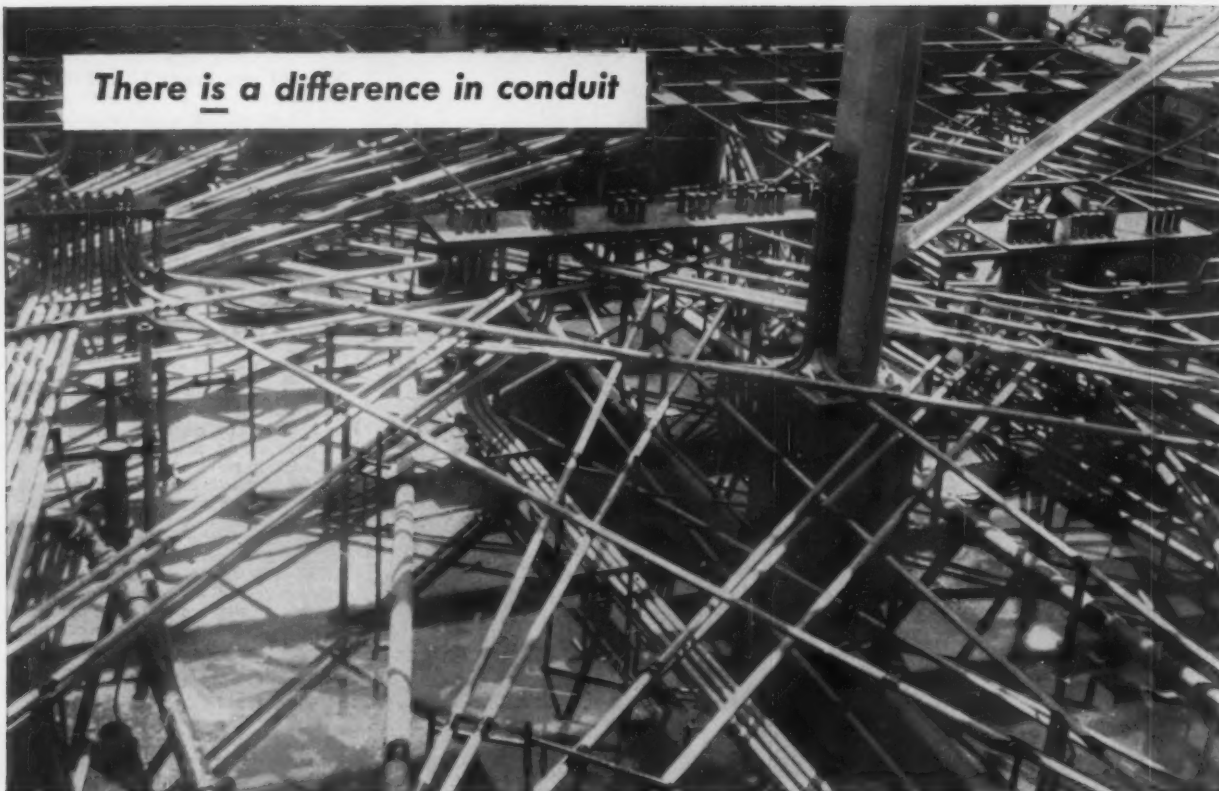
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NIZED conduit maintains its strength — will not deteriorate in concrete containing anti-freeze or accelerators . . . can be placed in direct contact with reinforcing rods without fear of electrolytic corrosion.

**With all the talk about what type of conduit to use . . . here are the facts on**

## **WHY IT PAYS TO USE G-E WHITE**

As you know, the first job of conduit is protection. This is one important reason why it pays to use G-E WHITE GALVANIZED steel conduit. In the first place, G-E WHITE GALVANIZED conduit is made of steel . . . and steel is the ideal material to protect electrical conductors from physical harm and guard buildings from damage in case of cable failure. G-E WHITE GALVANIZED steel conduit also gives you

top-notch corrosion protection thanks to the special galvanizing process which bonds a uniform coating of hot zinc over every square inch, including the threads. Wire pulling is easier with G-E WHITE GALVANIZED, too, because of the smooth, anti-friction interior coating.

You can use G-E WHITE GALVANIZED steel conduit under conditions that can adversely affect

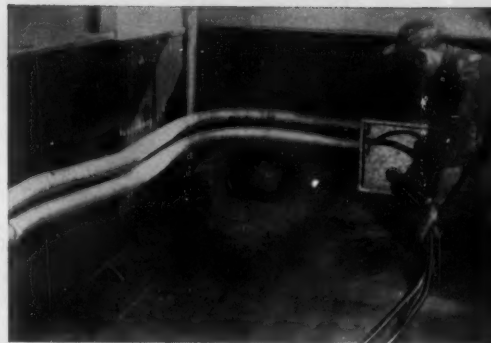
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**GENERAL  ELECTRIC**

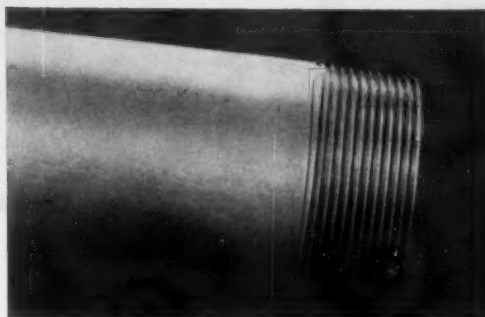




**2) NO SPECIAL HANDLING REQUIRED:** Because G-E WHITE GALVANIZED steel conduit resists physical damage, it does not require "kid gloves" handling on the job. You do not have to take special care in cutting, threading or bending as is the case with some conduits made of metal other than steel. G-E WHITE GALVANIZED can be cut with a pipe cutter, threads cleanly without special dies or methods, and bends smoothly without kinking, flattening, or marring.



**3) EASY WIRE PULLING:** Tough, durable G-E WHITE GALVANIZED steel conduit has a hard, smooth interior surface that resists gouging or hang-ups during fishing and wire pulling. Heavy pulls will not score the inside radius of elbows and bends. Furthermore, the interior of G-E WHITE GALVANIZED conduit is coated evenly with a corrosion-resistant paint containing a special anti-friction agent that results in up to 14% easier wire-pulling.



**4) ZINC-PROTECTED THREADS:** Threads stay clean and rust-resistant before and after installation because they are hot zinc-coated just like the rest of G-E WHITE GALVANIZED conduit. Because G-E WHITE GALVANIZED conduit is made of steel, the threads do not have to be lubricated to prevent them from "freezing" to the coupling... metal is joined direct to metal to give required ground continuity.

# GALVANIZED STEEL CONDUIT

some conduits made of metal other than steel. With G-E WHITE GALVANIZED steel conduit you don't have to worry about installations next to dissimilar metals, or in concrete mixes containing additives, or outdoors on absorbent materials. Regardless of the installation conditions, G-E WHITE GALVANIZED does not require any specialized installation methods.

The pictures on these pages illustrate just some of the factors you should consider before making your next conduit purchase. G-E WHITE GALVANIZED is rigid steel conduit at its best — proved in countless installations under the most exacting conditions.

For an informative booklet containing complete product information and useful data tables, send the coupon today.

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Conduit Products Department  
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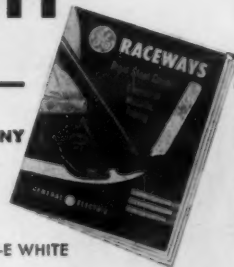
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# "Service means

*A Statement of Policy from Jim Grindell, General Sales Manager  
Killark Electric Manufacturing Company*

We are proud of the position Killark occupies as the leader in manufacturing aluminum conduit fittings and fixtures. That leadership results from pioneering the use of aluminum, steadily expanding our line and following a dedicated policy of service to the contractor and wholesaler. Killark can give you these advantages.

- 1. Long-term Experience.** More than FORTY-FIVE years' experience in the manufacture of conduit fittings, together with almost twenty years as exclusive manufacturers of ALUMINUM fittings gives us the "know-how" that comes with time and experience. Killark is the pioneer in this field.
- 2. Modern Design.** We are continually improving design and expanding the line by adding new items. Aluminum fittings have definite advantages in that they are rust-free, more corrosion resistant, lighter and therefore easier to use.
- 3. Complete Line.** Not just a few special-purpose products, but a full line in a complete range of sizes. In fact, Killark offers the most complete line of all-aluminum fittings and fixtures in the country today, and they are competitively priced.
- 4. Efficient Distribution.** The United States and Canada are thoroughly and efficiently covered by 27 experienced Electrical Agents. More than half of these men have been with us 25 years or more. There are 20 strategically located warehouses from which prompt delivery is made, giving you faster service.



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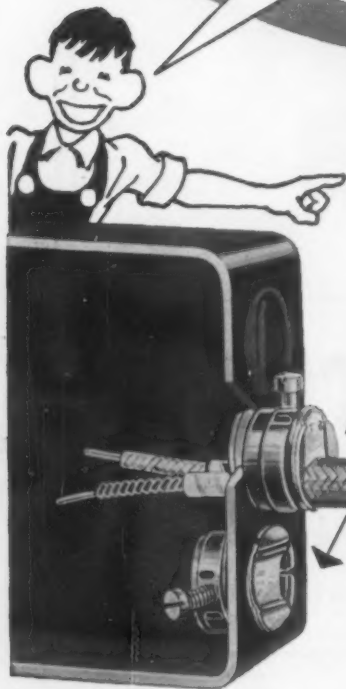
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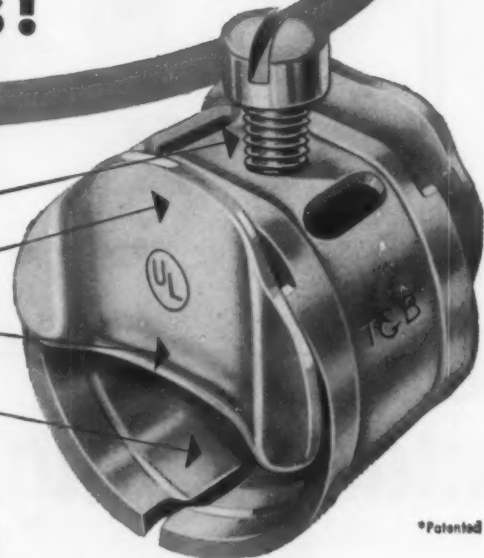
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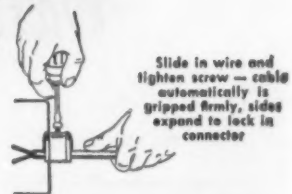
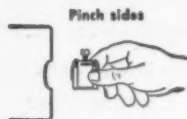
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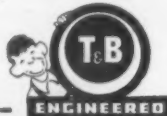
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## ***Lighting Challenge***

In the months since it was announced, the Blackwell Report on light and vision research sponsored by IES, appears more clearly as of the utmost importance to practical lighting application today and for the future. It may well stand as the greatest contribution to the art and science of illumination of this decade.

New footcandle recommendations by IES technical committees last year, based upon the research report, were discussed at practically every national and regional meeting of lighting engineers. The full import, however, was not immediately recognized. It took a while for the economic implications of the new lighting level recommendations, two or three times past practice, to sink in.

To put the problem in perspective—during World War II and after, the transition from incandescent to fluorescent lighting was going on. A two and one half times gain in lighting levels could be achieved on conventional electrical systems. More recently the 277/480-volt system has come into prominence, a substantial capacity gain with only a moderate increase in system cost. These "bonus" events, however, are non-recurring. There are no new light sources of spectacularly higher efficiency in immediate prospect, and 300 volts to ground is about as high as engineers are willing to design electrical systems today for general application.

Enhancement of lighting to the new recommended levels, consequently, involves the complete redesign of electrical systems often doubling the watts-per-square-foot supply. This has a further effect on air conditioning loads also requiring an increase in electrical system capacity. Efforts to apply the new recommendations have run repeatedly into the stern problem of cost in the commercial arena.

Knowledge is not reversible. The Blackwell research is on the record. It cannot be dismissed. The resulting lighting recommendations are practicable and feasible, but, by past standards, costly. It is not going to be easy to persuade owners and architects to quickly accept substantially higher costs for electrical work. Ultimately, however, the proceeds of the laboratory must be brought to the public in practical lighting installations.

The challenge is plain. The electrical industry has acquired a body of recommended lighting values based, for the first time, upon unassailable scientific findings. To achieve the new levels will take elaborate new power distribution systems as well as new lamps and fixtures. Their application will be costly. The educational and selling job involved will not be easy. But, as an industry, we cannot escape progress. The public should have the full benefit of our most advanced lighting technology.

*Wm. T. Stuart*

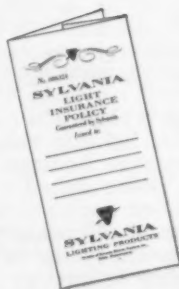
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## *Impact of New*

# **HIGHER LIGHTING LEVELS**

## *on Related Design*

The new Recommended Illumination Levels recently adopted by the Illuminating Engineering Society create many new problems in lighting and related design practice. Industry specialists discuss these problems and tell how they can be met in this timely report.

**T**HE lighting industry is currently experiencing some growing pains. It all began last year when the Illuminating Engineering Society adopted a new set of recommended lighting levels for a broad range of seeing tasks. These new lighting levels were, on the average, about double the levels previously listed as the Society's official recommendations.

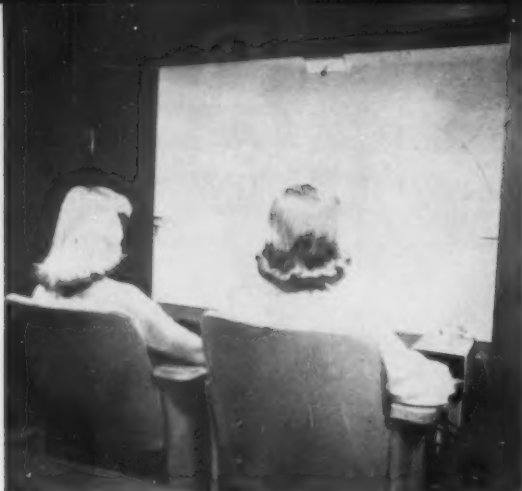
Industry reaction to the Society's announcement of the new lighting levels, hardly noticeable at first, gradually began to show up. Then, as the details of the results of the Blackwell studies (light and vision research on which the new levels were based) became known, the full impact of the new recommendations suddenly became apparent. It was evident that the industry was headed for a new surge of progress. Was the industry ready for this progress? Many industry people doubted that it was.

Prospects of this surge of lighting progress led to considerable industry self-analysis. The new lighting levels related to *quantity* of light only. What about *quality*, or visual comfort? Could the industry provide the new lighting levels and maintain visual comfort? And what about cost? Higher lighting

levels would definitely mean higher lighting costs. Would lighting customers accept higher lighting levels and the inherent higher costs? Further, these new levels meant still more heat to be handled by air conditioning systems, larger capacity wiring systems, a further aggravation of the problem of heat in ballasts, a pressing need for more efficient light sources, and a host of other problems.

Answers to these and other related lighting design problems are discussed in detail in eight separate articles, presented as a package on the following pages. These articles have been prepared by well known and nationally recognized authorities in the lighting and electrical design field, specifically for this editorial project. Most of these authors are also officers, past or present, of the IES.

While the new lighting levels may be considered ahead of general lighting practice, they are only level with, and in some cases behind, current advanced practice. The lighting industry does have the technical know-how, and the lighting tools, to meet the challenge of continuing lighting progress in a dynamic and growing national economy.



**CONTROL CUBICLE** and normal young observers were used by Dr. H. R. Blackwell to measure relationships of size, contrast, time and accuracy of seeing a luminous disc—all varying with various levels of brightness in the cubicle. This research work was carried out at the University of Michigan.



**LARGE WHEEL** was used, which rotates through a test area to simulate a field operation where the eye must scan the detail to be seen, such as reading or working on conveyor belt tasks, to translate static laboratory conditions to usual dynamic eye-movement conditions in performing work tasks.

## Laboratory Eye Sets

# New Lighting Design Practice

Lighting is on the threshold of an exciting future, now being sparked through continuing research in light and vision.

By **C. L. Crouch**, Technical Director, Illuminating Engineering Society, New York, N. Y.

**H**OW can one design the lighting for ideal seeing? From the enthusiastic claims of articles and catalogs the layman might well gather the feeling that he has but to speak the word, pay the bill, and "Utopia" is his! We have come a long way toward good and lovely lighting because of greater knowledge and experience. But do we really know how good the lighting should be for best seeing? Too often the users dispute the lighting recommendations of the contractor or the lighting engineer. Too often the designer does not have the courage of his convictions to stand up to his own ideals of best lighting.

Many people say, "What do the Doctors recommend?" assuming that the medical doctors know what the eyes need physiologically. I believe everyone thinks enough of

their eyes as the key to their activity during every waking moment that they would gladly satisfy the needs to assure best seeing, whatever those needs may be.

### Need for Research

In view of these deep-seated desires the Illuminating Engineering Society set up through a Trust Agreement an independent research organization, called the Illuminating Engineering Research Institute, which should find out through research at Colleges and Universities the answers that the field has so long needed. This Institute, composed heavily of vision researchers, has thought through the problems and initiated a program of research in light and vision which is proceeding vigorously on a broad front

involving the quantity of illumination, the quality of lighting, and the environmental conditions for best seeing.

### The Concept of Research

Out of this whole development has come a very practical concept: "How do we design an enclosure—an envelope about the human organism in space—for maximum efficiency of operation, and livability in 'feeling'?" Applying this to lighting, how do we design a luminous environment for: (1) optimum seeing, and (2) interesting stimulating atmosphere for maximum motivation and morale of the worker? It will take years for research to learn all the answers to these two objectives, but we have made a good start.



### Research Starts at Focal Point

A good design starts with a focal point. The focal point is the work to be seen. All the rest of the design (the elimination of glare and the proper brightness balance of surrounding areas) must supplement the carrying out of that work at the focal point. The age-old question bobs up: "How much light is necessary to see the work?" Dr. H. R. Blackwell has completed an 8-year research at the University of Michigan on visual performance, and out of this has developed a basic method by which we can determine the light necessary to see any field task in the work a day world. This method is based strictly upon visibility, and does not embrace the optimum rate of seeing, or evaluate maximum ease or minimum effort. These latter items come later in the research program, when suitable criteria can be developed with enough sensitivity and reliability to give repeatable and irrefutable results. We have good indications in these directions, and we will not be satisfied until we achieve the complete knowledge of the relationships of all factors that contribute to maximum speed, efficiency, and ease of seeing. For now, we will settle for plain visibility of the tasks. Dr. Blackwell used young adult observers with normal, or normally-corrected, vision. They recorded the visibility of a standard test object, a luminous disc of varying size and contrast as seen against a background of varying brightness—all carried out in a large uniformly bright control cubicle. The measurements covered sizes from an extremely tiny spot of 1 minute, to 64 minutes, corresponding to large detail. The time interval of viewing varied from 1/1000-second to 1 second, and the brightness of the background changed from .001 to 800 footlamberts.

Once having determined how the eye sees a standard test object, it was necessary to relate the laboratory data to field conditions of "moving" eyes and differing detail of various work tasks. The "moving" eye factor was determined by observing detail in a large moving wheel passing at differing speeds in front of the observer. The relation of various work tasks to the standard luminous disc was determined by varying the contrast of the luminous disc until it was equally visible through an optical instru-

ment (contrast threshold meter) to the given work task. Once the equivalency was established, the laboratory data with the "moving eye" factor included could be used to determine the illumination necessary to see the task at a given rate of performance. This rate of performance was based upon a complete degree of accuracy, and an eye-pause of  $\frac{1}{2}$ -second, found to be the average pause of the eye in reading and scanning.

### Typical Tasks in Commerce and Industry Measured

How many footcandles do we need for various locations in commerce and industry (assuming no glare and proper brightness balance of surroundings)? The Illuminating Engineering Society, through its committees, had to determine these from Dr. Blackwell's Method, and his measurements of typical tasks. The application committees of the Society, such as Office, School, Store and Industrial, sent in over 56 tasks representative of their fields. These were measured by Dr. Blackwell's Visual Task Evaluator. Some of these tasks are described below.

The Joint Task Committee on School Lighting, consisting of representatives of the American Institute of Architects, the National Council for Schoolhouse Construction, and the Illuminating Engineering Society, decided several years ago that pencil writing with No. 2 pencil on matte white paper would be considered the commonly-found more difficult task in the classroom. Accordingly, Chairman John Chorlton, of the Toronto Board of Education, obtained 31 samples of handwriting from 6th Graders and sent them to Dr. Black-

well. Of the 31 samples, 12 (or 40%) were grouped together toward the lower range of visibility, because of poorer contrast. The average indicated the need for 63 footcandles.

The office secretary often uses a No. 3 pencil for long dictation periods to avoid frequent sharpening of a supply of softer ones. The sample measured required 76 footcandles.

The original copy of typed letter usually is sharp and bold, but the fourth carbon copy was found to require 133 footcandles.

The garment industry is concerned with the economy of its precision cutting. With many dark patterns it is easy to see the chalkmarks. The tricky ones are those lighter patterns which blend with the chalkmarks. For instance, for a brown tweed with an orange chalkmark, it takes 266 footcandles to see the markings.

In textile mill tasks, it was found that a broken black thread on a spinner-bobbin required 2900 footcandles. The broken end is scuffed loose by the operator, and then is seen by slight shadow and highlight effect against the rest of the thread on the bobbin.

Lumber defects as seen by the grader vary greatly in the amount of light required. The light required to detect the defects in a sample of redwood lumber varied from 71 to 381 footcandles.

Proofed type requires a bright source reflected in its surface to be seen. Measurements indicated the need for more than 3000 footlamberts in a broad area highlight. On the same principle, vernier calipers need 630 footlamberts.

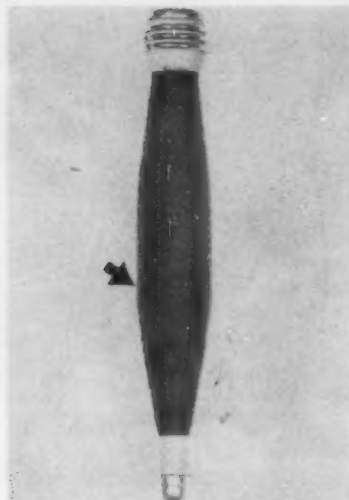
Spots and stains sometimes are hard to see. A brown stain on gray



**THIS DEVICE** is a Visual Task Evaluator which Dr. Blackwell used to reduce contrast of an unknown field task to threshold vision and equate it to a known task, a 4-minute circular disc.



**STENOGRAPHIC** writing with No. 3 pencil, one of 56 field visual tasks studied, requires 76 footcandles of illumination.



**BROKEN** black wool thread, another of the 56 field visual tasks studied, is seen by slight highlight and shadow on spinner bobbin, and requires 2900 footcandles.



**SPOT** on gray cloth was also submitted for testing, and required 1100 footcandles for seeing under specified test conditions.

## LIGHTING LEVEL RECOMMENDATIONS

For Some Typical Visual Tasks

Visual Tasks	Footcandle Values New	Old
<b>Office</b>		
Stenography, filing . . . . .	100	30
Bookkeeping . . . . .	150	50
Reading handwriting in ink or medium pencil on good quality paper . . . . .	70	30
Reading high-contrast or well-printed materials . . . . .	30	10
<b>Drafting</b>		
Detailed work, designing . . . . .	200	50
Rough layouts . . . . .	150	50
<b>Schools</b>		
Penciled handwork . . . . .	70	30
Reproduced material (spirit reproductions)		
Good . . . . .	30	30
Poor . . . . .	100	30
Reading high-contrast or well-printed materials . . . . .	30	30
<b>Cloth Products*</b>		
Inspection . . . . .	2000	30-300
Cutting . . . . .	300	30-300
Sewing . . . . .	500	30-300
Pressing . . . . .	300	30-100
<b>Machine Shops</b>		
Rough bench or machine work . . . . .	50	20
Medium bench or machine work . . . . .	100	50
Fine bench or machine work, fine polishing . . . . .	500	100
Extra fine bench or machine work, grinding . . . . .	1000	200

\*An area in which contrasts are particularly poor

cloth required 1100 footcandles, a brown spot on a red necktie required 2400 footcandles.

### Interpretation Into Footcandle Recommendations

The Society's committees took these measurements, and analyzed them into categories of difficulty, and compared them with the many other tasks found in offices, schools, stores, institutions, residences, and the many types of industrial plants. As a result, a comprehensive list of new recommended values has appeared in the new 3rd Edition of the *IES Lighting Handbook*. Some typical examples are shown in the table "Lighting Level Recommendations," which compares the new recommended values with the previously recommended values.

### Do Recommendations Prove Out in Practice

After all the laboratory measurements—after all the interpretation and application to the field—do they actually *prove out* in every day practice? Let me quote three examples:

1). Douglas Aircraft installed 400 footcandles for assembly of electronic components. The value of these components varied between \$100 and \$10,000 each. The rejects dropped from 28 to 3 with an average saving of \$2500 per day. Migraine headaches dropped from 4 to 0 and absenteeism was reduced

to zero. Resulting employee morale was very high.

2). The Metwood Company installed 200 footcandles in an assembly shop dealing with very small metal parts. An independent auditor determined the results over a three-year period. There was a 16% increase in output, 28% decrease in rejects, 58% decrease in lost time due to accidents. The cost of installation was paid off by the savings in eight months' time.

3). The Erickson Tool Co., by going to 200 footcandles for the general area and 300 footcandles for the difficult seeing area, increased the output 10% and paid off the installation in three months. Additional benefits resulted in 20% decrease in rejects and 50% decrease in minor accidents.

#### **Research Points the Way to More Than Footcandles**

Sometimes lighting engineers are called "Footcandle Engineers" by those who question their recommendations. Woe be to us if we prove to be only such, especially with these new higher levels of illumination! Now, as never in the past, we must engineer the whole luminous interior into a smooth, integrated effect of a pleasing well-lighted interior. There must be no high brightnesses toward the eye. There must be no overly light or dark areas; there must be a blend-

ing in the whole field of view. There must be a pleasing use of color, with accents, and change of pace. There must be an avoidance of monotony in lines and patterns. It would not be amiss to team up with architects, colorists and interior designers to provide that interesting, stimulating, inviting atmosphere, along with illumination, for efficient seeing. In this way the user never ceases to enjoy the thrill of his new installation with nary a murmur of discordant elements.

In the meantime, research relentlessly moves on to find the answers for insuring the right effects (which are now determined by rules-of-thumb). Cornell University is right now determining how bright large window areas can be, or how bright luminous areas of electric lighting can be. The University of Rochester is finding out how much change or variation one can have when looking from one part of the room to another. The University of Texas is determining suitable color combinations for pleasing and stimulating interiors. The University of California and the Toronto Board of Education are determining the losses of contrast due to reflections of overhead lighting equipment in pencil-work and printed material. (Already appreciable losses have been measured and we will need to take steps to guard against these losses which are

equivalent to throwing away a large part of the light being delivered from direct-indirect equipment.)

And last, but not least, Dr. Blackwell is going on to find the light necessary for faster vision, and for younger and older eyes. Dr. Weston of England has found preliminarily that there is a loss of 7% per year, as we leave the early 20-year-old state. If this continued we would all go blind at a comparatively early age. Fortunately the curve bends horizontal toward the latter 40's and 50's. The older, more skilled worker needs far more light! We need to know "how much" soon, for the sake of efficient operation of the older workers in commerce and industry. And the educators already are asking us how much we need for the child's undeveloped eye.

Then, too, Dr. Blackwell needs to measure many more tasks in commerce and industry, in order to specifically answer the needs of special applications in the increasing complexity of industry, and reaching even into offices and commercial establishments in keeping with the new ways of doing things.

Dr. Blackwell and his associates are already engaged in measurements for establishing a new basis for street and highway lighting.

Thus, through continuing research, in all phases of light and vision, we stand on the threshold of an exciting future in lighting.

## **Environment**

### **and Higher Lighting Levels**

Visual Comfort, indoors or out, depends in part on the brightness, colors and textures of the surround. As lighting levels increase, need for proper brightness ratios and reflectance values also increases, to provide a visually comfortable environment.

**By George J. Taylor\***, Past President (1958-59), Illuminating Engineering Society

**A** GREAT deal has been written and spoken concerning the new higher lighting levels. All of this discussion appears to lead to one general specification: caution. Extreme care must be taken in planning our lighting systems in ac-

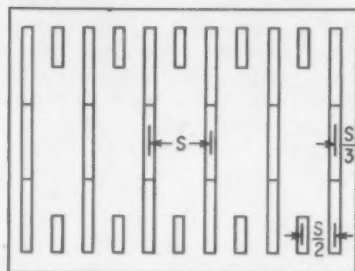
cordance with the standards of today. Actually this is nothing new. In each of the surges toward higher levels in the past, new problems have arisen to challenge those specifying, installing and maintaining these systems.

One of the considerations constantly requiring attention has been environment—that which is about us. Today more than ever before

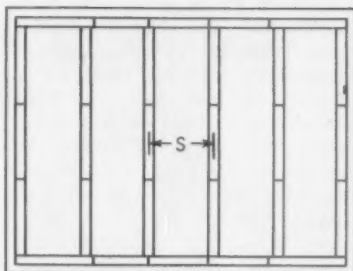
there is a need for greater emphasis on the overall significance of environment in the considerations for designing a lighting system. With the direction being taken toward higher footcandle levels, the lighting designer and interior designer can no longer travel separate paths toward the design of the completed space. The two must integrate their thoughts toward a com-

\* Vice President, Director of Research and Development, Day-Brite Lighting, Inc., New York, N. Y.

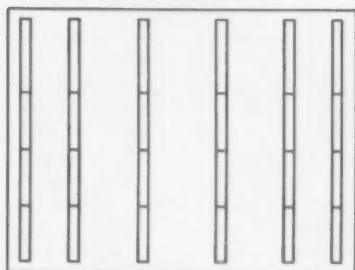
## FOR UNIFORM ILLUMINATION . . .



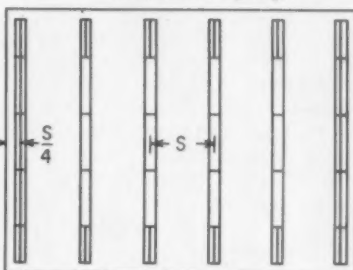
Increase units at wall...



Install perimeter lighting...



Use nonuniform spacing...



Increase lamps at wall.

**LUMINAIRES** can be arranged so that they provide uniform lighting, improve brightness ratios, create a comfortable visual environment.

mon goal of providing the best possible visual environment. Just as heating and air conditioning provide thermal comfort, and acoustical treatment provides sonic comfort, lighting and space decoration must provide visual comfort. Neither light nor decoration alone can do it. Visual comfort must be the result of joint effort.

Except for the extremes of weather there would be no reason

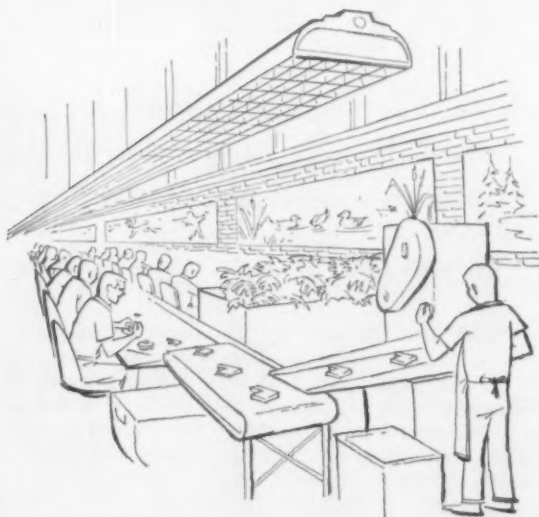
for not having workers perform their duties out-of-doors. Since there are 1,000 footcandles available in the shade of a tree, with all of the proper brightness conditions, the worker would be receiving illumination far in excess of most of the current lighting recommendations. However, because of the fickle nature of the weather, workers and machines cannot be exposed to the vast temperature differences

and the extremes of heat, cold, snow, sleet and rain. They must therefore be protected by the framework of a building. Thus to achieve thermal comfort, visual comfort had to be sacrificed.

In earlier days there was little visual comfort in evidence. Many installations had high brightness sources mounted in gloomy surroundings—dark ceilings, floors and walls. Of late there has been some improvement, as evidenced by the acceptance of lighter colors.

As we enter the new phase of higher lighting levels resulting from the researches of the Illuminating Engineering Research Institute, attention to environment becomes increasingly important. This is not to say that installations of all kinds must be monotonous in approach. In certain areas such as stores and lobbies there may be a requirement for glitter and high brightness. Environment is varied to meet the needs for space utilization. The lounge and cafeteria should be treated in a completely different manner than the work areas of an office or factory. People need change to relieve the boredom in what may be repetitious jobs. Psychologically they receive a "lift" when exposed to a change in atmosphere during breaks in their work day.

The need then is to vary the environment to fit each individual work task. By careful evaluation of the factors involved it is possible to provide proper environment for the higher lighting levels.



**MURALS**, depicting outdoor scenes, and planters, to serve as room or area dividers, help to create a comfortable visual environment and psychologically pleasant place to work; increases efficiency, boosts morale, pays dividends—even in industry.





**VISUAL ENVIRONMENT** of a typical conference room can be improved simply by addition of wall lighting, using standard luminaire on ceiling near wall as shown. Photo upper left shows usual lighting treatment, with resulting dark walls, poor brightness ratios. Photo upper right shows effect of wall washer lighting only. Bottom photo shows final lighting result when both lighting elements are used. Note the resulting uniformity of brightness, which greatly improves the visual comfort.

In discussing the new IES footcandle levels and environment, we must not lose sight of the necessity for quality and high comfort in most of the applications involved. Whatever decorative taste is deemed esthetically correct and regardless of the lighting system chosen, both must ultimately yield an environment which will meet with IES recommendations for room reflectances and brightness ratios as well as the footcandle level.

Judicious use of lighting equipment is one of the means at our command for creating pleasant, "want to work in" environments. The lighting fixtures used in an installation should all be functional—they should all serve a purpose. This means that each lighting fixture used must play some part in creating the overall lighting system. Illumination must be provided

where it is required to provide light for seeing and light for comfort.

In designing a lighting installation in a relatively large office or industrial area it is a simple matter to put on paper the required number of fixtures indicated by the calculations. This results in achieving a lighting installation with an average footcandle level which is high in the interior and low around the perimeter. Since the perimeter area is as important as the interior, increases can be made in the level in these areas. Walls parallel to fixture rows can benefit by moving rows closer to the wall and opening up spacings in the core. There are several ways of treating walls perpendicular to rows; including the doubling of the number of fixture rows immediately adjacent to the wall, increasing the number of lamps in the last fixture in each row, or running an extra row of

fixtures parallel to all walls. All of these systems to bring the maximum footcandle level, and the minimum, close to the average level, result in owner benefits which allow him to use every square foot of available floor space for productive purposes.

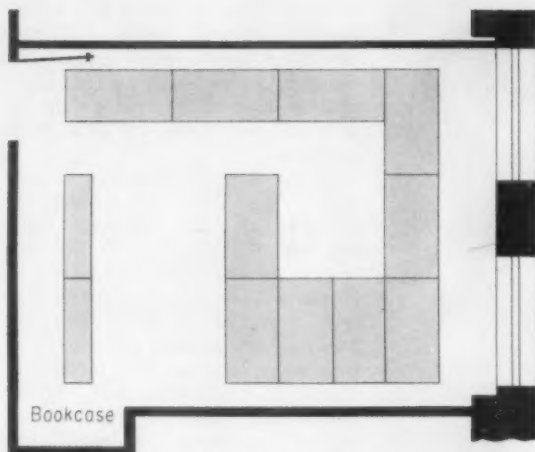
In the conference room this concept is carried to the extreme by using fixtures as a valance to light the walls. These side fixtures contribute to the overall illumination on the table, increasing the lighting level from 58 to 83 footcandles. However, their main purpose is to provide an increase in the side wall illumination and, therefore, brightness to make the environment pleasing and to bring the installation within the recommended brightness ratios. Thus a ratio of 25-to-1 for table-top-to-side-wall without wall lighting, is changed to a very satisfactory ratio of approximately 1-to-1, with wall lighting. And the decisions made in the room are made under conditions which lend themselves to serious, prolonged concentration without the strain and fatigue which improper lighting balance would have created.

Too often in our concern for providing footcandles with linear sources we lose sight of the repetitious appearance which straight runs of fixtures create. How much more interesting a varied fixture appearance or design pattern would be in a store, office or factory!

Many have been critical of trans-lighted ceilings because of the lack of appeal of the plain diffuse ceiling material. By providing acoustical baffles, two purposes can be served: sonic comfort, and relief from monotony. If baffles are not practical then possibly strips of acoustical material can be used for the purpose of breaking up the lack of pattern.

Today the interior designer can even create in color the decor of the dropped ceiling. A new world of design creation has been opened by the introduction of colored plastic panels, lined color panels, and small-cell plastic egg-crate louvers, also in color. An entire new lighting vista is possible since the interior designer need no longer be obliged to deal only with a white ceiling.

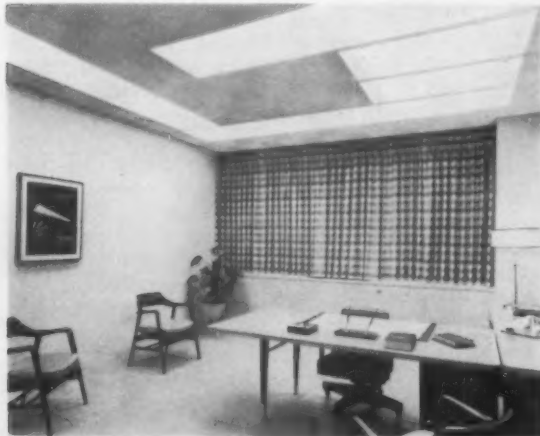
Advances in ballasting and controls have added another dimension to our technology. Dimming equipment now allows each individual in a private office to establish his own mood lighting. Experience



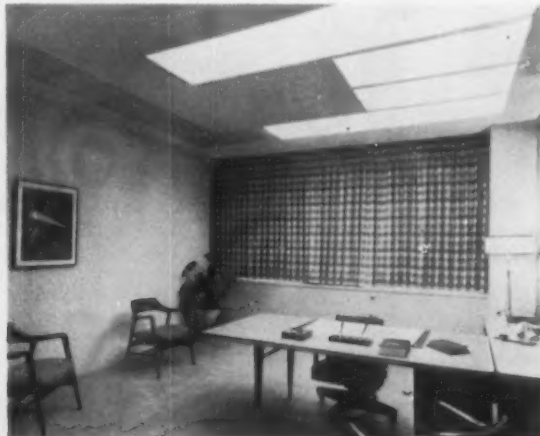
**LIGHTING LAYOUT** for private office, with non-symmetrical luminaire pattern, provides functional lighting, with 200 footcandles on desk, and visual comfort. Luminaires are multiple-switch controlled, for variable lighting effects. Separate switches control the 12-in.-wide troffer near left wall above, and the four luminaires along upper wall. Two switches control the remaining six luminaires over the desk area.



**NORMAL VIEW** from desk includes pale blue painted wall (center), flanked on left by medium green painted wall, and on right by off-white papered wall. Gray carpet with pale green tint ties wall finishes together for pleasant effect. Function of 12-in.-wide recessed troffer, and table lamp, is to create comfortable wall brightness in conformance with IES recommended practice.



**VISITOR'S VIEW** of office is also visually comfortable when all lights are on (photo, left). Elimination of lighting from 24-in. recessed troffer above left wall does not affect lighting level on desk, but results in undesirable brightness ratios.



has shown that individual adjustment invariably leads to a choice of higher lighting levels when performing difficult seeing tasks. The use of dimmers in larger areas also permits change—the biggest factor in erasing boredom.

Whatever system used, the governing concept used in providing footcandles must continue to be the functional use of equipment to provide light where needed, whether to provide footcandles on working surfaces, or proper brightness conditions on other surfaces.

This concept of functional application of lighting equipment is most evident in the executive office shown. Here the lighting equipment is established in a definite pat-

tern to provide maximum illumination on the work plane. The one-foot-wide troffer does not contribute one footcandle to the desk top, but does supply the necessary brightness to the end wall to create a proper visual environment for the person occupying the office.

A small sofa and table, complete with lamp, help to separate this office from the stereotyped business office. The room furnishings are extremely important to bring about a homelike atmosphere. Coupled with the furniture are the general room decorations. Each wall is treated with a different effect. The window wall is carefully covered with drapes. One side wall is papered and other two walls

painted. Each painted wall is of a different color. The floor is covered with a carpet which serves to tie all the decorative elements together. Pictures on the wall make the entire room look complete. The busy executive retains a fresh approach to the business at hand, stimulated by the restful environment in which he must perform his work.

While the above speaks in reference to a private office, similar treatment can be expanded and applied to other larger areas. Schools have been the quickest to adopt the philosophy of making rooms more pleasant to be in. Through the use of "happy" colors younger children associate school with days of play and happiness. This same feeling

can be translated into the thoughts of the worker who finds his office a nice place to be in. Proper environment stimulates good work habits, and combined with proper lighting, improves efficiency and reduces errors.

Interest in decoration need not stop in any size area. Even the use of different colors on columns in a large area serves this purpose. Originality leaves no limit to the number of decorative ideas possible. By providing an outdoor mural and planters, the owner of one company has been able to provide restful surroundings. As his workers pause to collect their thoughts or rest their eyes, they see not blank walls but a touch of the out-of-doors.

There is no reason why this same treatment cannot be extended into the factory itself by the use of planters to separate work areas. As long as there is no need for solid partitions because of a need for isolation, why not allow green foliage to perform this function?

It has often been proven that people are affected greatly by their mental attitude toward work and the place in which they work. By

creating an environment which is visually pleasant, morale is boosted. The simple added touch of a decorative mural, pictures on the wall, or garden atmosphere may be just the spark needed to provide this desire for doing better.

"I just don't like to work under fluorescent lights" is an oft-heard remark, especially among women workers. The complaint is usually not against the quantity, or even necessarily against the quality. The most usual complaints deal with the color of the fluorescent source providing the illumination.

Cool white lamps provide a crisp cool atmosphere, but unfortunately do not make women workers look their best. Where a great many women are employed it would be well to use a warmer lamp such as white. In very critical areas, such as private offices, areas without windows, or selling areas, the use of deluxe color lamps would be worth the additional cost brought about by lower light output.

Combining the possible lamp colors with the possible paint colors can allow the decorator a wide range of design imagination. Bear-

ing in mind the recommended room reflectances of the IES Recommended Practices, there are still an abundance of variations from which to choose to present a pleasing effect.

Very few of the above concepts are new, or startling, but they do emphasize that despite the rigid requirement of adhering to proper brightness ratios and room reflectances, there is still an open market on ideas for overall environment. While there are basic rules that must be followed to insure visual comfort, the flexibility within these basic rules allows for extreme originality. All of this leads to the basic end result of providing a lighting system in which people will be comfortable and happy.

The overall environmental effect is something that appears pleasant to people in the room, and without them knowing what it is lets them enjoy the overall esthetic effect. It simply makes you feel good and want to come back to the place, or enjoy being in it. This has a direct psychological effect on people and also upon their human performance as workers.

## *Impact of New Lighting Levels on*

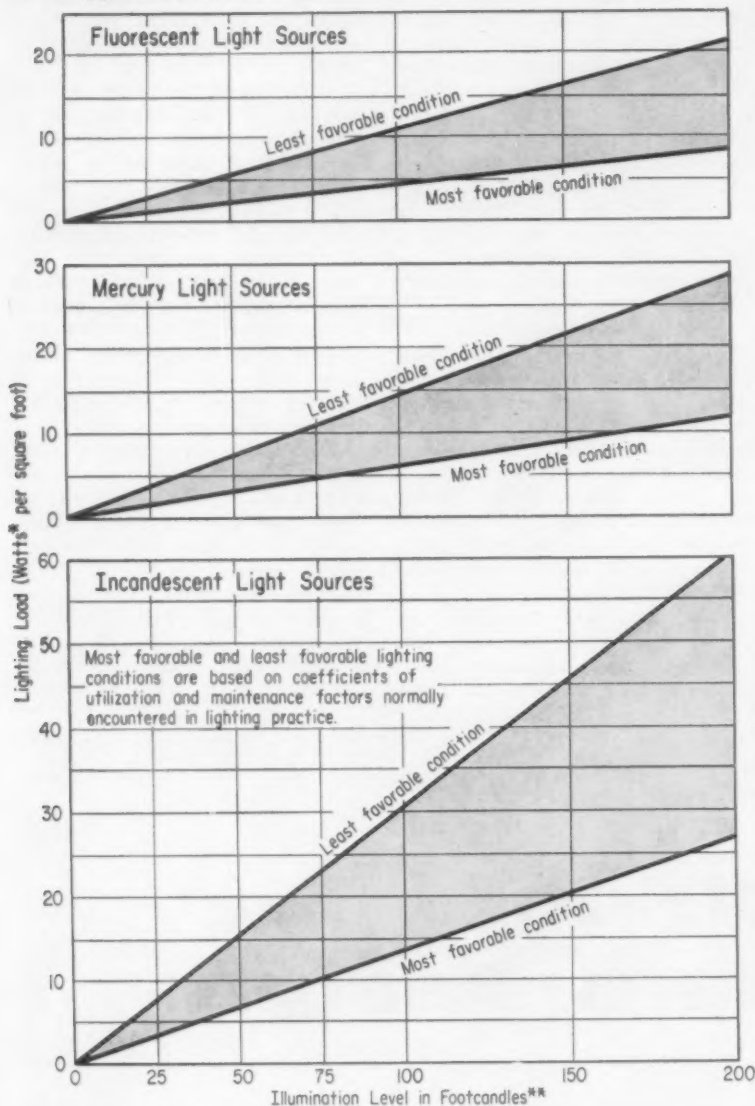
# **Electrical System Design**

Higher lighting levels create many problems in electrical system design, which preclude generalized conclusions. In most cases these problems are compounded, especially when air conditioning and power loads are involved. Recommended procedure is to make a detailed study for each specific project; however, a less cumbersome approach is presented herein.

**By Mark Eitingon, P.E.,** Consulting Electrical Engineer,  
Eitingon & Schlossberg Associates, New York, N. Y.

**T**HE occasion of the recent establishment of new and higher lighting levels, under the sponsorship of the IES, represents the rare instance in the history of electric lighting, that such recommendations have been made without a simultaneous unveiling of a newly developed light source, providing a greater lumen-per-watt efficiency. The new light sources, that are showing up at this time, are providing more lumens per cubic inch of lamp. However, barring the present application of higher electric supply frequencies to fluorescent lighting installations, which is only providing a 2% improvement in overall electric to light energy con-

**CHART I—Relation of Illumination Levels to Electrical Energy Dissipation**



\*Includes  $\frac{1}{2}$  watts loss of 2-lamp ballasts, where applicable.

\*\*All values based on average lumen output during lamp life.

version, there is no new technique of producing light from electricity being made available, at the present time. Therefore, nothing new is available which would tend to offset the direct relationship between high percentile increases in lighting level to high percentile increases in electrical utilization.

All this boils down to the fact that the impact of the new and higher lighting levels on electrical distribution systems is, simply and obviously, to make them larger and more expensive than ever before. In turn, this means that in the proc-

ess of accepting the new lighting levels, everyone concerned will not only be examining some cold hard facts about the capital and operating costs of lighting equipment (as well as the returns that can be anticipated from investments in lighting), but will also be casting a careful eye at the initial costs which will evolve in electrical distribution systems due to the new lighting levels.

In the hope that a little light will be provided to assist in this latter "seeing task," a few facts and figures are presented here which carry

the consideration of the higher lighting levels from service to outlet box, but no further.

The effect of the new lighting levels on electrical distribution systems is a very generalized topic, whereas the design and economic factors involved in such electrical distribution systems have accurate significance only when considered in relation to specific cases. The proper way to approach the overall problem, therefore, would be to study as many specific "before and after" cases involving the new lighting levels as would be necessary to permit the deduction of satisfactory generalizations. This procedure is, of course, impractical and would probably rule out the development of timely results even if undertaken by a large study group. To become practical, therefore, facts and figures are presented in two basic steps. Firstly, figures are given which will permit the development of some very rough ideas about the distribution system dollars which are attached to lighting levels; and secondly, a few facts are given which will point up, in a general way, the complications which can be expected, when considering specific cases, and which will be the major causes for augmenting any estimates evolving from a naive approach.

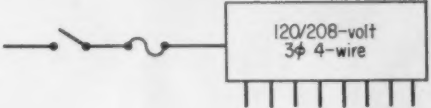
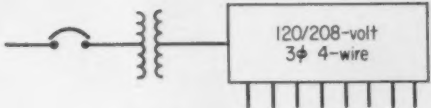

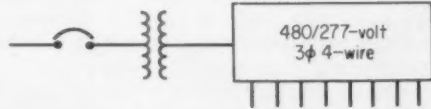
Chart I indicates the conversion of lighting intensity units (foot-candles) into the electrical power units of "watts per square foot," which of course are the significant units from the electrical distribution standpoint. The data in the chart is suitable both for base, as well as for incremental, considerations.

If it were true that electrical distribution system design is based on the theory that individual increments of load are handled by individual isolated systems, it would be possible to augment Chart I with some figures, such as those shown in Chart II.

These figures in Chart II constitute the results of an academic study of various "service to outlet box" distribution systems, which were taken to be completely isolated, serving no other purpose than to provide a "wattage level" to lighting type outlets, distributed over a large square area from a service installation located at one corner. On the assumed basis, then, Chart I combined with the figures in Chart II provides a rough and



## CHART II—Initial Unit Costs for Electrical Distribution Systems for Lighting Loads

Description of System	Schematic Diagram	Initial Cost (Per watt per sq ft)
Service and distribution up to lighting outlets at 120/208 volts, 3-phase, 4-wire		14¢
Primary service. Distribution from service point up to lighting outlets at 120/208 volts, 3-phase, 4-wire		16¢
Service and distribution up to lighting outlets at 277/480 volts, 3-phase, 4-wire		11¢
Primary service. Distribution from service point up to lighting outlets at 277/480 volts, 3-phase, 4-wire		13¢

ready way to cook up a price tag for the distribution system backing up a specific lighting level. Unfortunately, the assumed simplifying theory about load increments is false, and when considering the added load due to a higher lighting level, there are some factors which have a "cost impact" on the design of an overall distribution system which may completely overshadow the cost per watt per square foot figures developed on the "individual isolated system" basis, and which cannot possibly be overlooked.

These factors can be listed as follows:

(a) Providing for greater capacity usually implies working with a supply system which has a higher short circuit capability. This in turn means that over-current devices must have higher interrupting capacities, and busways and switchboards require stronger bracing of their current carrying parts. In new construction, this implies that an incremental load may very well impose a more expensive electrical system design program throughout the entire project. On an existing system a complete modification or abandonment and replacement of all important distribution components become distinct possibilities due to an incremental load increase in line with the factor here discussed.

(b) The fact that utility companies and code authorities tend to force consumers of electricity to employ a one-feed point, or single radial distribution system, for their entire load, means that, on new construction, conveniently located multiple services will not be available, as assumed in the establishment of the cost figures given above. On an existing system, this fact means that an incremental load increase may force the abandonment and replacement of project service equipment, for capacity reasons only.

(c) In existing installations, the patchwork procedure necessary to integrate additional lighting outlets and circuitry with existing outlets and associated switch control, will cause a greater expense than would be anticipated for the isolated wiring that would be necessary for the additional outlets alone.

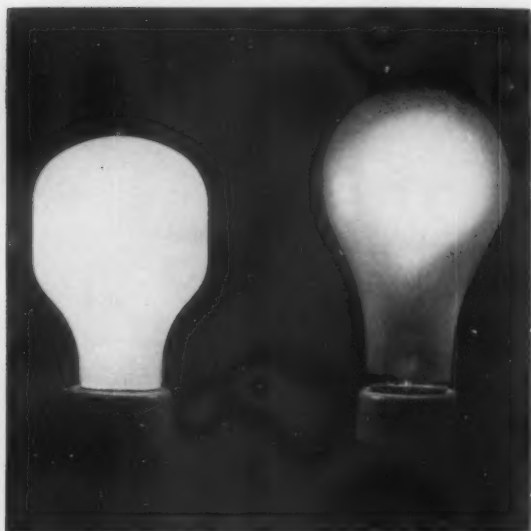
The discussion so far has been concerned with the direct impact of higher lighting levels upon electrical distribution systems. There are two factors which affect such systems indirectly, but whose impact is of major significance.

The first of these derives from the fact that, in an air conditioned space, each watt added, for an increased lighting level, introduces an average of four-tenths of a watt in the equipment consumption necessary to evacuate the additional energy introduced, from the space in

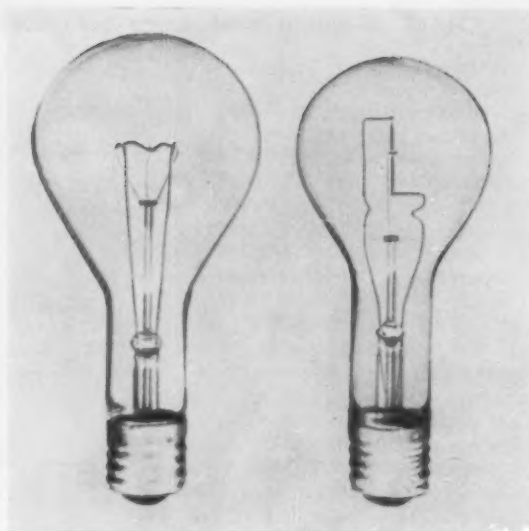
question. This may be viewed from the standpoint that all the problems mentioned heretofore are compounded, where air conditioned space is concerned, to the extent that the watts per square foot figures of Chart I are increased throughout by a factor of 40%.

The second point, to be considered here, is the fact that the advent of significantly higher lighting levels which represent large electric loads, that are fixed as far as location is concerned, will tend to terminate entirely the industrial practice of supplying lighting off relatively expensive distribution elements (such as plug-in bus duct), which are intended to provide electrical space flexibility. As an economic necessity, industrial lighting will have to be supplied independently from systems serving production equipment, and plant managers will have to start making decisions with regard to initiating electrical distribution practices geared specifically to serving lighting equipment.

In conclusion, it should be said that in spite of all the problems anticipated in electrical distribution systems, due to the higher lighting levels, there is no need to believe that such problems will provide a major impediment to general acceptance of the new levels, providing they produce the promised returns in "human efficiency."



**COATING** of silica on inner surface of small lamps, 60- to 200-watt sizes, improves light diffusion, conceals filament, reduces glare. T-bulb (left) is coated, A-bulb (right) is inside frost type. Both shapes are available with white coating.



**AXIAL** mounting of coiled-coil filaments (CC-8, right) increases light output up to 17% over similar lamps using old-style C-filament (left). Lamps with new type filaments are available in sizes from 100 to 1000 watts.

# Light Sources

## for Higher Lighting Levels

Recent improvements in fluorescent, incandescent, and mercury lamps will help to provide higher lighting levels economically and efficiently.

**By Marshall N. Waterman\***, *Past President (1956-57)*  
Illuminating Engineering Society

\* Manager—Commercial Engineering,  
Westinghouse Lamp Division, Bloomfield, N. J.

### RECENT IMPROVEMENTS IN LIGHT SOURCES

#### Incandescent Lamps

- Higher output general lighting lamps.
- Higher output reflector lamps.
- More widely available white coated lamps.
- Lamps with better light output maintenance.

#### Fluorescent Lamps

- Higher light output from all regular fluorescent lamps.
- Even more light from "Super" lamps in 40-watt and 96-in. high-output types.
- Increased lumens and life from the 1500 ma extra-high-output types.

#### Mercury Lamps

- Vastly improved maintained output through life (i.e., higher mean lumens).
- More lamps with heavy duty weather resistant bulbs for universal use.
- Lamps of deluxe improved color, for application in commercial and industrial areas where people look at people, and where improved color discrimination is needed.

**T**HE new IES lighting levels bring with them the need for careful analysis of the available choices among light sources for each lighting installation. This engineering task has been enlarged in recent months by the announcement of a number of new lamp types in addition to the already large variety in incandescent, mercury and fluorescent lamps. Since the prescribed illumination levels will be higher than in the past, more lumens per square foot on the work will be required. This will have to be obtained from either (a) more generated lamp lumens, or (b) more effective utilization of the lumens generated, or both. On specific localized seeing tasks a good deal may

be accomplished by improving the utilization of lamp lumens by better control, that is, by placing a higher percentage of the available lumens on the work. Success, however, depends on the selection of the right lamp with characteristics favorable to optical control. For general illumination the emphasis will be on the overall efficiency of lamp and luminaire combinations. In both situations the challenge of higher footcandles creates a challenge for better lighting quality—meaning control of brightness and brightness contrasts both on the work and in the surrounding field of view. In all cases this quality factor should enter into the choice of the best light source.

For a given utilization efficiency higher illumination level means simply more energy input. Since this means also an increase in the heat energy (Btu) there is an impact on air conditioning costs. This plus the direct lighting cost means higher electric bills for the user and places on the lighting engineer the responsibility of selecting light sources and systems of maximum efficiency in terms of IES recommended quantity levels and good quality. The cost of lighting includes carrying cost on dollars invested and maintenance costs as well as the direct cost of electricity. The illumination levels must be based on maintained light (this is what the user is really buying). Although the first cost of light sources is a factor it will generally



**REFLECTOR** lamps are available in a wide range of sizes, shapes, and types of light distribution.

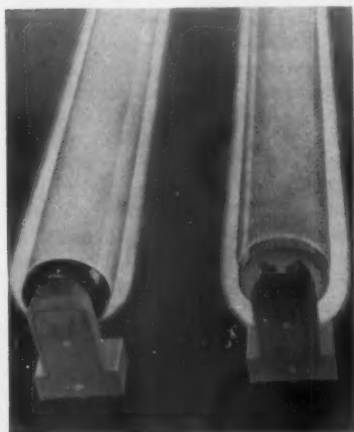
be small in relation to the significance of light output efficiency and maintenance thereof. For many situations, especially where there is need for relatively high footcandles on the task, it would obviously be difficult and impractical to light the entire room to the recommended value. Under these circumstances the illumination on the work is obtained by a combination of general lighting and specialized supplementary lighting. Precautions must be taken to insure that brightness ratios throughout the visual field are kept within desirable limits, and the directional quality of the

supplementary light must be carefully considered.

Some of the more recent advances in light sources that lend themselves to the implementation of the new IES recommended foot-candle levels are described below.

#### ***Incandescent Lamps***

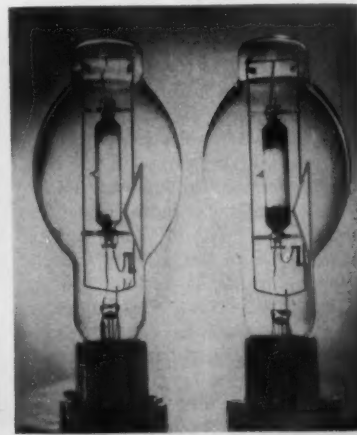
The lamp industry now offers several types of lamps for general illumination with the axially mounted CC-8 filament. This filament configuration has led to increases in both initial and maintained light output up to 17%. The



**TRANSLUCENT** white plastic base on fluorescent lamp at right (above) increases the apparent lighted length, as compared with lamp equipped with opaque base shown on left. This feature improves luminaire appearance.

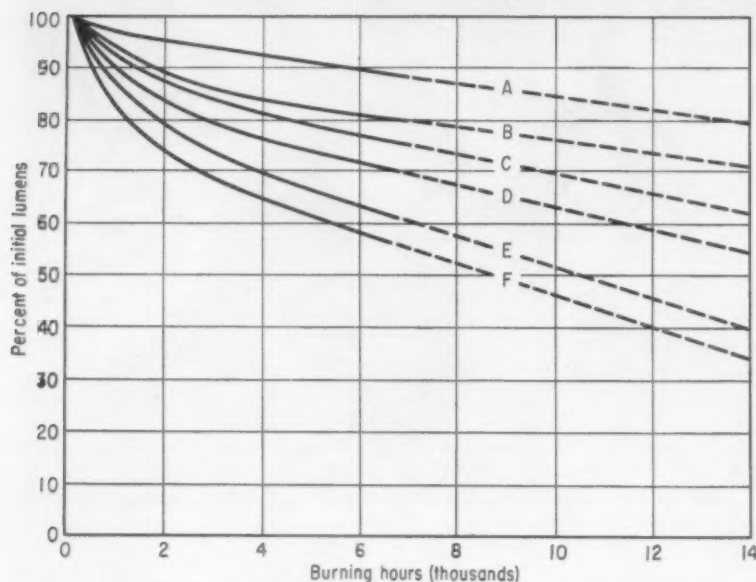


**NEW DEVELOPMENTS** in fluorescent lamps will probably include new shapes, such as shown here. Unit at right is a labyrinth lamp, an area source of light about one inch thick, a laboratory development now under study.



**NEW ELECTRODES**, with special emission material embedded within tungsten coils, to prevent blackening of quartz tubing, produces maximum light output throughout life. Note contrast in blackening of old style electrodes in lamp at right.

## APPROXIMATE LUMEN MAINTENANCE FOR TYPICAL MERCURY LAMPS



### Legend for Curves

Curve	Mercury Lamps
A*	H33-1, H35-18, H15LG
B	H18, H25, H17, H9
C*	H34-12
D	H1, H22, H15
E	H5, H24
F	H12, H4

\* These lamps equipped with non-blackening new electrodes.

**MERCURY LAMPS** are improving greatly in quality. Curves A and C show lumen maintenance for lamps employing new electrodes which prevent darkening of the arc tubes. Other curves are for earlier design lamps using regular arc tubes.

wattages presently available with the new filament range from 100 to 1000 watts. The improvements in light output have proved to be so significant in the lamps used for general illumination that the industry is moving in the direction of adding the axial filament to reflector lamps. This will result in an appreciable increase in efficiency in these types.

The lighting engineer now has a wide variety of reflector lamps from which to choose for both localized lighting and for general illumination ranging from the small 30-watt R20 lamp to the 1000-watt reflector lamp. In addition to the reflector lamps the lighting engineer also has a wide selection of PAR-type lamps which range in wattage from 75 watts up to 500 watts. Both of these families of lamps allow the lighting engineer to place a controlled amount of light exactly where he wants it without use of external reflectors. The reflector and PAR lamps also have the advantage that the reflective surface is sealed into the lamp so that it is not affected by dirt or the deleterious effects of industrial gases in the atmosphere.

Another innovation announced very recently by the lamp industry is a small tubular quartz lamp that has a very high initial light output

with nearly 100% maintenance of that light output throughout the life of the lamp. This amazing attribute is accomplished by the introduction of a small amount of iodine into the lamp when it is manufactured. The iodine acts as a scavenger to clean the black deposit of tungsten off the bulb wall and redeposit it on the hot filament. While this phenomenon has been known for many years, it is only recently that it has proved to be feasible for commercial production. The lamps that have been announced range in wattage from 500 to 1500 watts and from 5 to 10 ins. in length. As time passes this lamp will find its way into some areas of industrial application because it will permit compact reflector equipment giving good light control in a rectangular pattern.

When the incandescent lamp was first developed it was available only in a clear bulb. It thus became necessary in order to provide a diffuse light source to place a diffusing material, such as glass, parchment or silk, in front of the lamp. The development of the inside frost lamp improved matters somewhat.

However, in many cases it was still necessary to use a piece of auxiliary equipment in order to provide a suitable and efficient dif-

fuse light source. The last few years have seen the introduction of a new type of coating that is applied to the inner surface of the bulb wall to make a much larger light source available and thus reduce the amount of direct and reflected glare with practically no reduction in total light output. This is accomplished by a thin deposit of silica powder on the inner surface of the lamp as it is being made. Such lamps are applicable primarily for localized lighting or for lighting very small areas. They are generally available in sizes from 60 to 200 watts and are offered in two bulb shapes (see illustration).

### Fluorescent Lamps

Improvement and new developments in phosphor processing, lamp design, and manufacturing techniques have resulted in new performance peaks for fluorescent lamps. This overall development program has resulted in new light output highs for all lamps. For example, the most popular type, the 40-watt T12, now produces 2800 lumens in the cool white color as compared to the previous rating of 2650.

A new 40-watt T12 lamp containing a new cathode design and a mixture of rare gases produces up



to 3200 lumens, the highest output ever obtained from a 40-watt lamp. One design of such a lamp also incorporates a new concept in lamp manufacture in that it is also available with a translucent white plastic base. This results in an increase in the apparent lighted length of the lamp, as well as providing a much more attractive lamp both lighted and unlighted. These new super lamps will provide lower cost of light and provide higher foot-candles in new, as well as in existing installations.

Developments in lamp design similar to those in the new super 40-watt lamp result in 9000 lumens output from a new 96T12 high-output-type lamp as compared to about 8000 lumens from the standard lamp. The line of fluorescent lamps operating at 1500 ma (SHO, VHO, PG) have also been improved. The present ratings for the 96-in. lamp is 15,000 lumens, as opposed to the older rating of 13,500 lumens. The life of these lamps has been extended to 7500 hours. However, about 5000 hours is still the most useful economic life because of more rapid depreciation in light output than occurs in the 425 and 800 ma lamps.

The lamp industry has been working several years toward the development of a fluorescent lamp that will operate equally well on both the rapid start and preheat circuit. This has now been accomplished in the standard 40-watt 425 ma design as of this past summer.

### Future Developments

Recent announcements indicate that the next few years will see several new developments that will give the lighting engineer an even greater flexibility than he presently has. One of these developments that we can logically expect is that of a labyrinth lamp. This lamp is in the form of a thin, rectangular glass plate approximately one inch thick. It consists of a labyrinth, or a maze, of passages sealed in a glass block. The arc, or electrical discharge, travels this winding path through the glass block to produce, in effect, an area source of light the size of the flat glass plate (see illustration). Such lamps are not yet commercially available but announcements by more than one manufacturer indicate active work on them.

### Mercury Lamps

Mercury lamp development has been progressing at a truly remarkable rate, with one of the greatest advances having been made during the past year.

The development of a new double-wound cathode has enabled lamp manufacturers to make lamps that will produce approximately 90% of their original light output even after having burned 7000 hours, whereas lamps of conventional design produce approximately 70% of initial light output at this time. Because of this very important improvement in maintained light output these new lamps save 15% to 28% in the cost of light as compared with previous mercury sources. In addition to the improvement in light output, these lamps are also manufactured only with heavy duty weather resistant glass outer bulb, and are rated at approximately 10,000 hours life with about 9000 hours recommended as the economic life.

Along with increases in light output and longer life, have come improvements in the color of mercury lamps. A purple lustre coating on the outer bulb, and a red fluorescent phosphor, are combined to produce the best color yet obtained from a mercury light source. These lamps will find many applications in both commercial and industrial locations, where it has been the practice to use supplementary in-

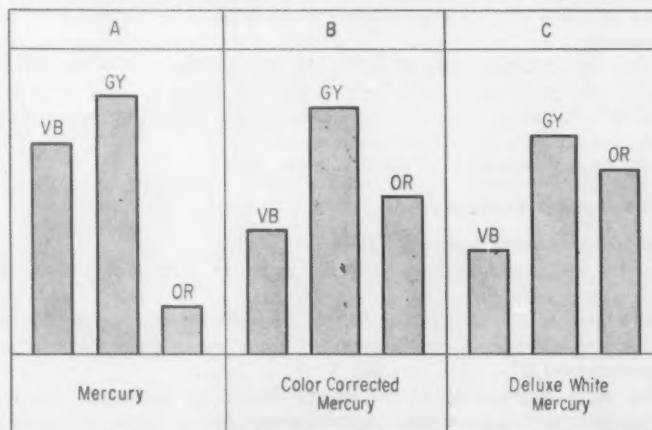
candescent or fluorescent lamps for good color rendition.

The industry has also extended the use of heavy duty weather resistant glass outer bulbs into many additional wattages over those available last year at this time. These include the entire 400-watt line, as well as the 250, 700 and 1000-watt sizes.

It can be said that the lamp industry has risen to the challenge of providing more efficient, more economical light sources. These are available to achieve the higher foot-candle and lighting quality levels called for by the new IES Recommended Practices. Improvements made over the past several months are summarized in the Table "Recent Improvements in Light Sources," and such progress may be expected to continue.

There are wide areas of overlap in the applicability of the various fluorescent, mercury, and incandescent lamp types. The challenge remains with the lamp industry to develop still further improvements and varieties. Immediately, however, the challenge is to the architect, consulting engineer, designer, builder and contractor to choose wisely among both the older and the newer lamp types for the most economical and best services to the user. In any case the lamp tools are available for the brighter and better electrically lighted future ahead.

### COLOR CHARACTERISTIC OF MERCURY LAMPS



**COLOR COMPOSITION** of mercury lamps varies with type of lamp. The regular mercury lamp (column A) is rich in the blue and yellow-green portion of the spectrum, and weak in the red zone. The color corrected lamp (column B) shows less blue, and more light output in the red portion. The Deluxe white mercury lamp (column C) has still less blue light, less yellow-green light, but still more orange-red light output.

# **Advancing Lighting Standards**

Lighting know-how has long paced building design and technological progress. But today, with advancing lighting standards, the need is for more completely effective lighting tools and more imaginative applications of these tools.

**By Wilbur D. Riddle, AIA**  
Resident Architect,  
GE Lighting Institute

and

**John E. Flynn**  
Advanced Application,  
Development Group, GE Lamp Division

## **Follow these Suggestions to Make Lighting—**

- 1. Lower in Cost**
- 2. More Comfortable**
- 3. Better in Appearance**

### **A. In Commercial and Public Buildings**

1. Use higher wattage fluorescent lamps.
2. Use louver materials of lower transmission, of metal or opaque materials, of improved optical qualities—for better light control and more comfort.
3. Use small cell louvers for finer texture, better looking luminaires or equipment.
4. Make use of accent colors on luminaires and louvers.
5. Use shielding angles even greater than those now considered good practice.
6. Make use of larger area of ceiling for illumination.
7. Give more attention to use of lighting for heat source in commercial and industrial buildings. Also give more attention to removal of lighting heat load for economy in air conditioned space.
8. Insist on high standards of visual comfort ratings.

### **B. In Industrial Buildings**

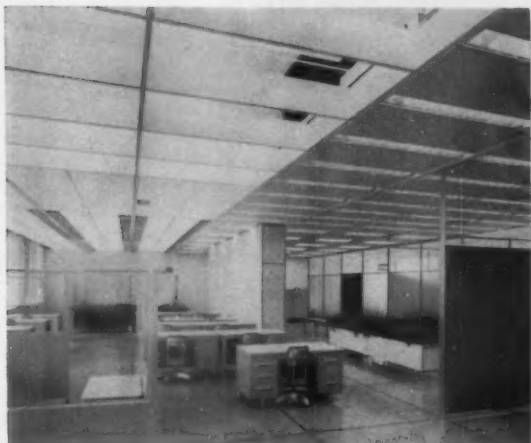
1. Use cross louvered luminaires more frequently.
2. Specify wedge-shaped cross louvers for better control of length-wise brightness.
3. Make greater use of specular finishes for reflector and louver finishes to control brightness. Materials chosen should have good maintenance characteristics.
4. Give more attention to lighter weight fluorescent luminaires. Recent developments in ballasts and high frequency power distribution greatly reduce ballast weight and thus allow more freedom in design.
5. Use more care in providing shielding and upward light for mercury and filament lamp luminaires.
6. Consider possibilities of large-element fluorescent luminaires similar to floating panels used in offices.

**R**ECENT discussions with fellow architects on opportunities for them in the design of more distinctive, more completely useful interiors, with lighting, have become a special challenge. Architects are keenly interested in the new possibilities of integrating light with acoustical treatment, heat and air conditioning, into designs that will be effectively modern for many years. They are discovering in the currently recommended IES levels of illumination a break-through in realizing long-sought appearance values.

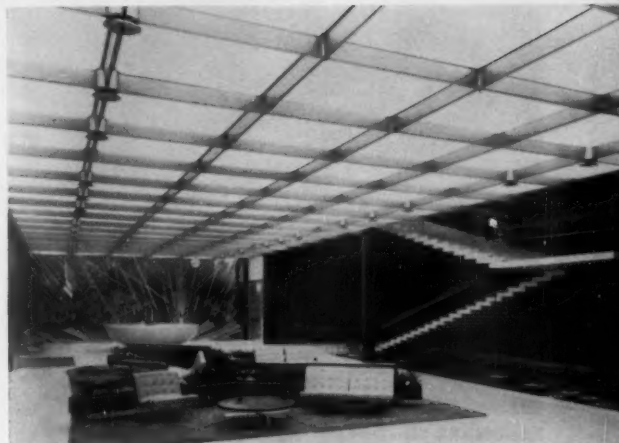
In this connection they ask how the lighting industry is fixed to give them equipment that can assure the promise of efficient illuminants. In asking this they are aware of the need for refined tools which eliminate glare in delivering the advanced comfort levels. They want these tools to have beauty of appearance, in completed installations, as well as features for ventilation and air conditioning for luminous ceilings. They want the electrical design to provide for all integrated facilities without ballast hum or the intrusion of any sound accompaniment. And they want all this with economy, too.

There is a larger expectation in these things architects are asking the lighting industry to provide. The prospect of using approxi-

## INTEGRATION FOR ARCHITECTURAL SOLUTION



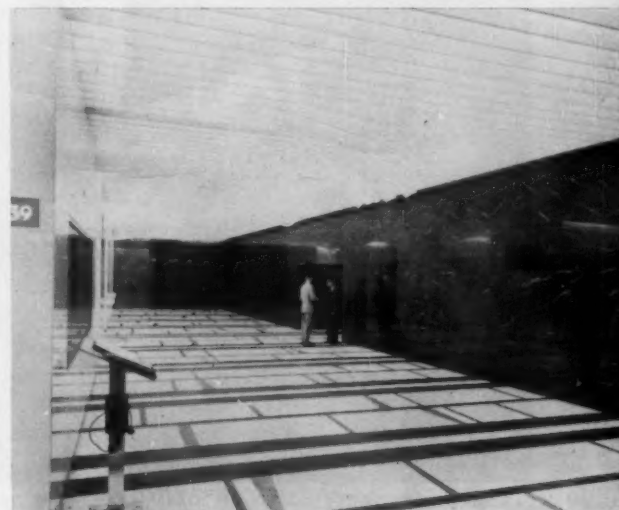
**STANDARD LIGHTING EQUIPMENT**, plus acoustics and air conditioning are shown here in full scale mock up, including color, furniture, everything contributing to total environment.



**LIGHTING, AIR CONDITIONING**, acoustics, sprinkler system are combined in one "symbolic garden effect" with respect for scale, harmony and overall architectural unity.



**SLIGHT CURVED FORM** in ceiling introduces a dominant note in this large banking room. The lighting element embraces all facilities in the ceiling package. Total environment is one of cheerfulness and pleasant harmony.



**LIGHTING DESIGN** permits the artist to combine a flowing sculptured ceiling with a geometric pattern in the reflecting floor. Imaginative use of baffles as dominant feature of the system suggests how fresh uses of elements may offer an area of expression for the artist.

mately daylight levels freely for interiors suggests a new freedom in designing buildings. "Inside" space has become less of a problem to architects as improved lighting has tended to overcome the prestige of "window" space. Now, with the new levels, which promise satisfactions for the most difficult seeing tasks, at all work locations, we have even further values to realize.

Advanced lighting, with its techniques for control and balance of brightness, provides more beneficial use of window space by making it comfortable from "inside" loca-

tions. At the same time, it liberates us from orienting interiors and work locations with reference to windows. Architects can handle brightness patterns to equip interiors with flexible visual treatments for larger aesthetic and functional goals.

"Mood" control, with changing brightness patterns, and the introduction of subtle color components, is influencing a revolution which will be the distinctive feature of late twentieth century buildings. Architects have always been concerned about their influence in cre-

ating the emotional appeal of interiors with well integrated design. Today, lighting art and science are offering the means for achieving this objective with realization in new dimensions, for exteriors as well as interiors.

To get to where it is possible to go with the new values in illumination, it is not necessary for the architect to become a lighting expert. It is rather a matter of him becoming aware of what is available, and to know how to put the skill of engineers to the consummation of design objectives. The en-

## SPECIAL EFFECTS FROM INTEGRATION



**LANDMARK BUILDING** distinguishes its location by displaying its interior lighting as exterior design. The glass curtain wall, plus the lighting, brings the entire structure into useful harmony with its dominant lighting feature.



**STANDARD FIXTURES**, imaginatively applied with careful detailing, produce an overall integration with architectural distinction. Fixtures here are part of design, not an added mechanical supplement.



**STANDARD SPOTLIGHTS** accenting the altar, become textural in themselves, as well as specially significant to the illumination objective.



**FIXTURE FORMS** contribute as much to this well integrated interior as their function. Dining space takes on a high styled appearance in this composition of large luminous areas blended with a variety of directional components.

gineers, for their part, are eager to demonstrate their appreciation of concepts that go beyond the functional demands of comfortable seeing. Their influence in inspiring equipment for advanced practice has already provided answers to questions architects are asking.

Applied technology has in the past impressed the architect as too often testing the adaptability of human beings. Most of us have experienced, within recent memory, less than full satisfaction with lighting and air conditioning systems. In the past, we were so eager to speed the advance of technology we adapted to what was offered in

these facilities. As we have developed our skills in how to combine them, without prejudice to one or the other, we can make our overall plans serve human sensibilities. Indeed, we can accord them a fine return on their prior cooperation.

Better design is on the way with better opportunities for architects to do a better job for their clients. While we await this development let us give some attention to some problems of the immediate present.

Tools now available to architects are more satisfactory than most of them suspect. Nevertheless, the advance in recommended levels will demand still more ingenuity in the

design of equipment. The introduction of brighter sources makes it imperative. So equipment will improve in variety and refinement, and more rapidly as architects become more precise in specifying what they want.

They have always wanted better styling, or, at least, they wanted units which would inspire the hope of good appearance as well as functional adequacy. Architects have worried about mass produced items having the combinations of color and texture and mechanical adaptability to accommodate their overall objectives.

This diffidence seems to us more



a reflection of a basic lack of confidence than a real problem. There are many choices today which permit the full development of imaginative lighting designs. New materials and new design elements, such as the curved-wedge louver blades, which control and shield the higher brightness sources, offer functional characteristics the new levels demand. The new plastic metal or metalized plastic panels have control features, plus rather exciting style possibilities, to combine with ventilation and air conditioning. Reduced weight, thin cross sections, introduction of high frequency operation of fluorescent lamps, are some of the attractions which advanced levels are bringing. These features add up. In unit type installations, or in complete ceiling panels, there is a great richness of resources to be tapped. Color and texture and scale, a combination dear to the architect, are available in fixtures for the expression of new dimensions in design.

Almost all elements entering the plans for interiors today present a tremendous increase in design possibilities. Architects should not miss the point that they can develop good professional results whether their budgets call for a system of fixtures or permits a choice from the variety of luminous ceiling treatments. The ultimate system and the completed interior test the designer's skill on many points. The architect, confident of his intuitions and aesthetic projections, must always feel some surprises in the integrations he finally achieves. He hopes his surprises will always be pleasant ones his clients will be glad to share.

One thing he can be certain about. He will have to rule out imitative reliance on existing successful examples of advanced lighting. Repeating the system used in a finely done interior is no guarantee of the same result for every situation. The whole concept will have to be a harmony of associated fac-

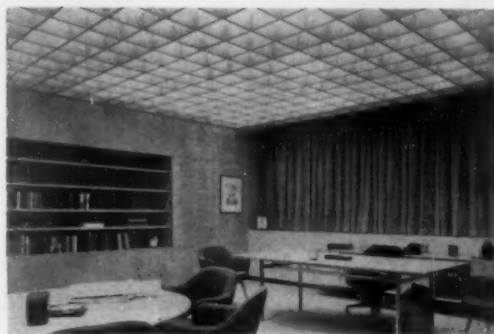
tors. Room colors and surfaces are a part of the success of the lighting system which is itself an aggregate of design elements which require integrative skill.

The special challenge to us in all this, as architects with careers in lighting, lies in the newly awakened interest of alert members of the profession. They anticipate the probability that their past reservations will be fully dispelled. From the past, individual practitioners have an accumulation of gripes, real or fancied, which beget today's questions. The architect observing advanced or experimental installations today begins to dream of the personal expression he can introduce with this medium into his own designs. In his dream there recurs the nagging wonder if the dream can come true. Will he be able to get the custom touch within the limits of his clients' budget? We believe he can if he takes the time and trouble to discover what is presently possible.

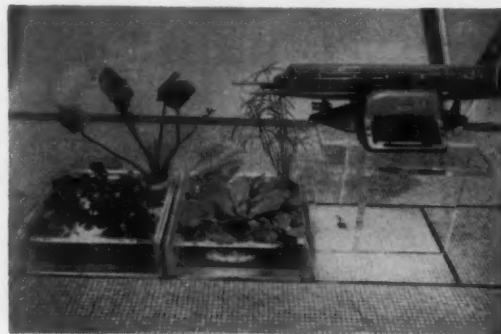
## HIGHER LIGHTING LEVELS



**STANDARD INDUSTRIAL FIXTURES** were grouped into an architectural panel for this office. This equipment delivers more than 400 footcandles comfortably. Although industrial fixtures were the basic component the carefully engineered control of brightness suggests that industrial installations of tomorrow may be as attractive as other types of work space. Acoustics and air conditioning are accommodated in the lighting provision.



**TOP EXECUTIVE OFFICE** with more than 400 footcandles, at highest value has prestige appearance enhanced with the system of wood baffles shielding lamps. The baffles control brightness as an incidence of their contribution to the impression of taste.



**WHILE WE USUALLY LOOK** to the ceiling and upper walls for location of lighting elements, this eye-catching display depends upon translucent floor material. Distinctive features of design become more varied as new materials for use with lighting come to market.

## DRESSING UP SPACE WITH FAMILIAR EQUIPMENT



**"LINED PATTERNED SURFACES"** offer a repeated harmony here. This, the ceiling pattern of lines of troffers, plus the lined pattern of the blinds and room dividers add up to distinction.



**SIMPLE ELEMENTS** combined with creative mastery here achieve the "lined pattern surface" with a different technique. Here, with downlights between aluminum edged baffles, table tops and floors reflect light to accent the aluminum.

## FINESSE WITH FIXTURES



**HOW TO GET COVE** lighting effects without coves? Here are solutions for two interiors, one with a low ceiling, the other a high ceiling. Coves would have changed the character of both rooms. Indirect lighting from fixtures have created preferred results simply, effortlessly.



**PROFESSIONAL RESEARCH** work calls for top functional values in lighting. The lab may look handsomely workmanlike, too. Structural ceiling members suggested the integrated services treatment. Large area, floating fixtures confer a direct solution, appropriate to the space and basic to integration of air and sound and light control.



**AN ARCHITECT** can meet an unusual challenge, as in this instance, where inside space, formerly a passageway, was transformed into an attractive professional office. For the drafting board, comfortable high-level illumination. General lighting from large luminous panels is supplemented with accent spots for highlighting the opposite wall.

Looking back over professional enthusiasms of architects and lighting men, we note the long term popularity of the curtain wall, and the more recent evolution of the luminous ceiling. The curtain wall has long since proved its case and is well established for the future. The evolving luminous ceiling, still appearing in newer forms, is an excellent reference for the shape of things to come. The luminous wall will not displace the curtain wall, but it will extend the experience in large ceiling elements. It will provide one of the directions in the fast developing process of giving architects and designers a range of desirable alternatives.

It is in the picture we see for the future that the care imperative in design will insure the precision in function and the beauty in appearance that observes scale and rhythm dear to architects.

We have come a long way already on the road towards these more perfect things the future must provide. The old egg crates of early fluorescent days had a simple homeliness that looked good compared with the exposed lamp units. The egg crates expanded and the cells multiplied until the whole ceiling was covered with them in the early louverall systems. A host of developments have come along since then, and with every advance in lamp efficiency new urgencies produced new equipment and appropriate techniques. The very simplicity of the early luminous ceilings tempted users to push the limits of these systems.

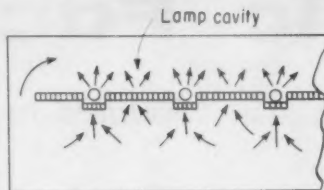
### Lighting Horizons

By combining filament and fluorescent elements we discovered how to multiply the strength of good features of both types of lighting. There have been a great variety of combinations tried. We understand the proportions more fully as we apply the benefits of past experience to new problems.

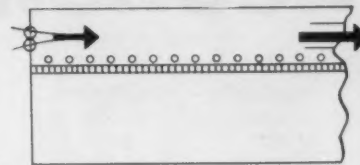
The restless push of venturesome innovators who turn to lighting for solutions to problems we had not conceived to be in its domain keep stretching the mind's hopes of what may come. The very fertility of concepts keep new variables arising to complicate the advance of the art. But definite forward steps are made year by year.

We have turned to anatomy to bare the bones of systems past so

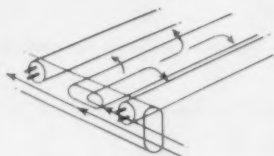
## SOME TYPICAL METHODS OF VENTILATING LUMINAIRE



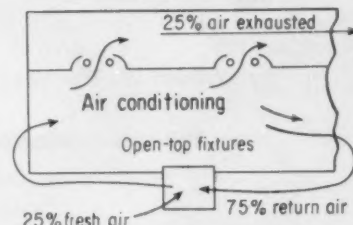
Natural Ventilation  
Floating panel luminaire with open grid



Forced Exhaust  
Sealed, "sandwich" type system



Forced air through fixture frame

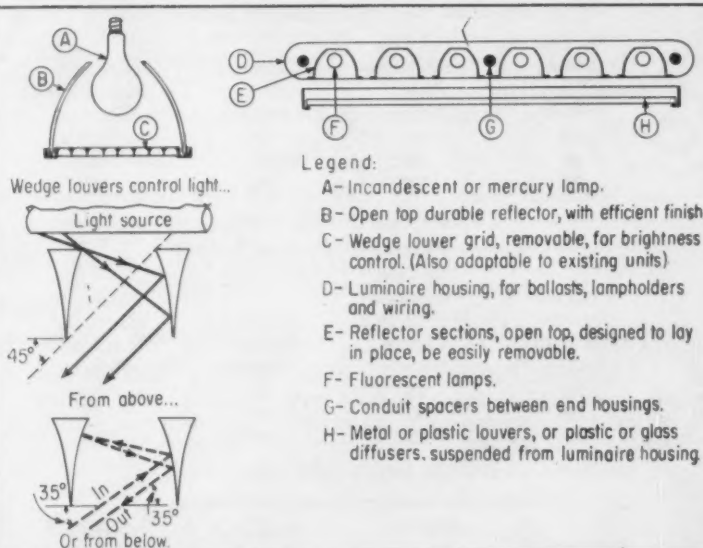


**FLUORESCENT LAMPS** lose efficiency when operated in high temperatures. Improvements are being made in luminaire dimensions, in the placement of lamps and ballasts, and in ventilation (see above typical methods) to permit lamps to operate at or near optimum light output.

that we might project the dynamic flesh and blood systems we see for the future. Lighting wins new areas of sure accomplishment, although its responsibilities turn to fresh fields continually. Even so, the growing ratio of lighting investment in building demands that

the architect, who seeks to get the effect he desires, will be able to get it without frustration. We have suggested in the illustrations some of the more helpful ways towards realizing objectives that will keep us eager and interested in still better things to come.

## LUMINAIRE FEATURES FOR BETTER INDUSTRIAL LIGHTING



**SOME LIGHTING TOOLS** which will aid in providing good industrial lighting are shown above. Parabolic wedge louvers offer a new approach to good shielding for higher lighting levels. When louver surfaces are of proper parabolic design, good shielding plus high light utilization results. All light entering from above comes out by a single reflection. However, louver brightness in the shielded zone below louver is affected by reflected brightness of room surfaces.

# Economic Factors

## Related to Higher Lighting Levels

Progress in light sources development, plus creative design in lighting application, will enhance lighting investment, and create a continuing demand for higher lighting levels.

By Willard W. Thompson, R. E., Thompson Engineering Company, Boston, Mass.

**Table I—Luminaire Cost Analysis**

	(Per Unit Cost)			
	Luminaire	Installation & Distribution	Lamp	Total Unit Cost Installed
Mercury.....	\$51.00	\$40.00	\$25.50	\$116.50
Incandescent Hi-Bay...	5.00	12.00	4.90	21.90
Fluorescent 2-Lamp F96PG17.....	45.00	22.00	4.20 (x 2)	75.40
Fluorescent 2-Lamp F96PG17.....	71.50	22.00	7.50 (x 2)	108.50

These luminaire unit costs, installed, were used in the cost analyses shown in the accompanying tables.

**Table II—Details of Three Industrial Lighting Systems**

(Selected as Basis for Economic Comparisons)

### SYSTEM NO. 1 (120 Volts)

#### Combination Mercury-Incandescent Systems

	Per Cent Mercury H400WRS1 Fixture	Per Cent Incandescent 750R52 Fixture	Quantity Mercury Fixtures	Quantity Incandescent Fixtures
a.	75	25	75	39
b.	50	50	47	79
c.	25	75	22	112

### SYSTEM NO. 2 (277 Volts)

#### Combination Mercury-Fluorescent Systems

	Per Cent Mercury H400WRS1 Fixture	Per Cent Fluorescent F96T12/HO 2-Lamp Fixture	Quantity Mercury Fixtures	Quantity Fluorescent Fixtures
a.	75	25	75	38
b.	50	50	47	75
c.	25	75	22	111

### SYSTEM NO. 3 (277 Volts)

#### Combination Mercury-Fluorescent Systems

	H400WRS1 Fixture	F96PG17 2-Lamp Fixture	Quantity Mercury Fixtures	Quantity Fluorescent Fixtures
a.	75	25	75	21
b.	50	50	47	42
c.	25	75	22	63

NOTE—Above systems designed to provide 100 footcandles in an industrial area of 10,000 sq ft, with ceiling height of 30 ft.

THE most important element in higher levels of lighting is the economic factor in relation to our national economy. How can higher levels of lighting be accomplished and pay for itself in our analysis of operating business? Scientific studies have shown us the desirability of higher levels of lighting for the benefit of the physiological senses of the body in human performance, efficiency, and comfort. The complexity of the higher levels of lighting relate to the following:

- The lumen output per watt of light sources.
- The efficiency with which these light sources can be used in luminaires.
- Building design problems for integration of all materials, including lighting.
- Air conditioning load factor.
- Sound control.
- Initial investment.
- Operating cost.

Scientific research has gradually increased the lumen output of artificial light sources—incandescent, mercury, and fluorescent—thus providing the wherewithal for higher lighting levels. However, it is the application of these light sources to our everyday use that determines the economy of the investment and its resultant operating cost. Some of the most common faults in conventional designs are as follows:

- Poor installation and operating efficiency because of low coefficient of utilization.
- Annoying glare from the higher lumen output light sources.
- Annoying harsh shadows resulting from insufficient diffusion within the area lighted.
- Annoying radiant heat from the light sources.

It is essential that the application



of higher lighting levels conform to the fundamentals in design that contribute to physiological seeing efficiency and comfort. Quantity of light is important, but quality of light is equally as important. Therefore, both are economic factors that must justify the investment in lighting especially at higher levels. Quality results in controlled, efficient, comfortable seeing with consideration given to brightness ratios, light distribution, diffusion, and surroundings. Sometimes quantity may have to be sacrificed for quality in an economic situation that involves not only costs in lighting but also other factors, such as air conditioning equipment. However, higher levels of illumination are possible where lighting is designed into the overall concept of the architecture.

### Industrial Lighting

Higher lighting levels in industrial plants are normally applied by the use of exposed luminaires, provided with good shielding of the light source. It is possible to reduce the cost per lumen per watt that management feels reasonable for the benefits obtained through higher levels of lighting by the use of higher output mercury and fluorescent lamp sources.

Normally, studies show that a H400RW1 mercury lighting system provides the lowest overall cost per lumen output. However, the characteristics of this type of lighting

**Table III—Cost Analysis of Industrial Lighting Systems Installed**

#### SYSTEM NO. 1 (120 Volts)

##### Combination Mercury-Incandescent Systems

	Per Cent		Cost	
	Mercury	Incandescent	Mercury	Incandescent
a.	75	25	\$8,737.50	\$854.10
b.	50	50	5,475.50	1,930.10
c.	25	75	2,563.00	2,452.80

#### SYSTEM NO. 2 (277 Volts)

##### Combination Mercury-Fluorescent Systems

	Per Cent		Cost	
	Mercury	Fluorescent	Mercury	HO Fluorescent
a.	75	25	\$8,737.50	\$11,656.70
b.	50	50	5,475.50	11,130.50
c.	25	75	2,563.00	10,932.40

#### SYSTEM NO. 3 (277 Volts)

##### Combination Mercury-Fluorescent Systems

	Per Cent		Cost	
	Mercury	Fluorescent	Mercury	PG Fluorescent
a.	75	25	\$8,737.50	\$11,016.00
b.	50	50	5,475.50	10,032.50
c.	25	75	2,563.00	9,398.50

do not always provide the most desirable lighting. Combinations of mercury-incandescent and mercury-fluorescent are proving the most desirable as to lighting results, economy of installation, and operating costs. Higher levels of lighting are obtainable from a combination of mercury-fluorescent, though the initial cost is greater than that of mercury-incandescent. However, the combination of mercury and the new high output fluorescent

lamp is lower in operating costs, resulting in a more desirable installation. The charts show these related costs.

### Commercial Lighting

Commercial applications of higher lighting levels present a more complex situation. The interior decor and the cost per square foot of floor area usually determine the type of light source and lumi-

**Table IV—Yearly Lamp Replacement and Relative Costs**

#### SYSTEM NO. 1 (120 Volts)

	Per Cent		Number of Lamps Replaced		Lamp Cost per Year		Electric* Operating Cost	
	Mercury	Incandescent	Mercury	Incandescent	Mercury	Incandescent	Mercury	Incandescent
a.	75	25	31.3	48.7	\$798.15	\$236.83	\$1,500.00	\$1,446.00
b.	50	50	19.6	98.7	499.80	483.63	940.00	2,960.00
c.	25	75	9.16	140.	233.58	686.00	440.00	4,200.00

#### SYSTEM NO. 2 (277 Volts)

	Per Cent		Number of Lamps Replaced		Lamp Cost per Year		Electric* Operating Cost	
	Mercury	Fluorescent	Mercury	Fluorescent	Mercury	HO Fluorescent	Mercury	HO Fluorescent
a.	75	25	31.3	25.2	\$798.15	\$105.84	\$1,500.00	\$476.00
b.	50	50	19.6	50	499.80	210.00	940.00	936.00
c.	25	75	9.16	74	233.58	300.80	440.00	1,388.00

#### SYSTEM NO. 3 (277 Volts)

	Per Cent		Number of Lamps Replaced		Lamp Cost per Year		Electric* Operating Cost	
	Mercury	Fluorescent	Mercury	Fluorescent	Mercury	PG Fluorescent	Mercury	PG Fluorescent
a.	75	25	31.3	14	\$798.15	\$105.00	\$1,500.00	\$426.00
b.	50	50	19.6	28	499.80	210.00	940.00	1,050.00
c.	25	75	9.16	42	233.58	315.00	440.00	1,580.00

\*Above operating costs for electric energy are based on 2500 burning hours per lamp per year, and on energy cost of 2¢ per kwh.

# COST ANALYSIS OF COMMERCIAL LIGHTING SYSTEM INSTALLED

(Based on 100 footcandles in an area of 10,000 sq ft)

Table V—Suspended Luminaires

Table VI—Recessed Troffers

Table VII—Luminous Ceilings

Table V—Suspended Luminaires

LIGHTING SYSTEMS →								
	1	2	3	4	5	6	7	8
	Rapid Start 4-F40 T12/RS 120V 8' Long 35°C x 45°L	Rapid Start 4-F40 T12/RS 277V 8' Long 35°C x 45°L	Slimline 2-F96 T12 120V 8' Long 35°C x 45°L	Slimline 2-F96 T12 277V 8' Long 35°C x 45°L	High Output 2-F96 T12/HO 120V 8' Long 45°C x 45°L	High Output 2-F96 T12/HO 277V 8' Long 45°C x 45°L	Power Groove 2-F96 PG17 120V 8' Long 45°C x 45°L	Power Groove 2-F96 PG17 277V 8' Long 45°C x 45°L
BASIC DATA								
1 Rated initial lamp lumens per luminaire (standard cool white).....	10,000	10,000	10,100	10,100	14,600	14,600	26,000	26,000
2 Lamp life.....	7,500	7,500	7,500	7,500	7,500	7,500	5,000	5,000
3 Average watts per lamp.....	39	39	74	74	105	105	200	200
4 Watts per luminaire (includes ballast watts).....	184	184	182	182	264	264	480	480
5 Coefficient of utilization.....	.64	.64	.64	.64	.64	.64	.64	.64
6 Maintenance factor.....	.75	.75	.75	.75	.75	.75	.75	.75
7 Effective maintained lumens per luminaire (Items 1 x 5 x 6).....	4,800	4,800	4,848	4,848	6,998	6,998	12,480	12,480
8 Relative number of luminaires needed for equal maintained FC.....	208	208	206	206	142	142	80	80
INITIAL COSTS								
9 Net cost of one luminaire.....	44.65	45.05	41.50	41.90	48.50	48.90	80.50	80.50
10 Installation & distribution system cost per luminaire.....	25.00	23.00	25.00	23.00	27.00	25.00	34.00	32.00
11 Net initial lamp cost per luminaire including tax.....	3.50	3.50	4.48	4.48	5.88	5.88	10.50	10.50
12 Total initial cost per luminaire (Items 9 + 10 + 11).....	73.15	71.55	70.98	69.38	81.38	79.78	124.50	123.00

Table VI—Recessed Troffers

LIGHTING SYSTEMS →								
	1	2	3	4	5	6	7	8
	Rapid Start 4-F40 T12/RS 120V 8' L-1' W Lucite Diamond Lens	Rapid Start 4-F40 T12/RS 277V 8' L-1' W Lucite Diamond Lens	Rapid Start 4-F40 T12/RS 120V 8' L-1' W Plastic Louver 43° x 43°	Rapid Start 4-F40 T12/RS 277V 8' L-1' W Plastic Louver 43° x 43°	Slimline 2-F96 T12 120V 8' L-1' W Lucite Diamond Lens	Slimline 2-F96 T12 277V 8' L-1' W Lucite Diamond Lens	Slimline 2-F96 T12 120V 8' L-1' W Plastic Louver 43° x 43°	Slimline 2-F96 T12 277V 8' L-1' W Plastic Louver 43° x 43°
BASIC DATA								
1 Rated initial lamp lumens per luminaire (standard cool white).....	10,000	10,000	10,000	10,000	10,100	10,100	10,100	10,100
2 Lamp life.....	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
3 Average watts per lamp.....	39	39	39	39	74	74	74	74
4 Watts per luminaire (includes ballast watts).....	188	188	188	188	182	182	182	182
5 Coefficient of utilization.....	.56	.56	.50	.50	.56	.56	.50	.50
6 Maintenance factor.....	.75	.75	.75	.75	.75	.75	.75	.75
7 Effective maintained lumens per luminaire (Items 1 x 5 x 6).....	4,200	4,200	3,750	3,750	4,242	4,242	3,787	3,787
8 Relative number of luminaires needed for equal maintained FC.....	238	238	266	266	236	236	264	264
INITIAL COST								
9 Net cost of one luminaire.....	63.45	63.45	54.05	54.45	60.95	61.35	51.55	51.95
10 Installation & distribution system cost per luminaire.....	26.00	24.00	26.00	24.00	26.00	24.00	26.00	24.00
11 Net initial lamp cost per luminaire including tax.....	3.50	3.50	3.50	3.50	4.48	4.48	4.48	4.48
12 Total initial cost per luminaire (Items 9 + 10 + 11).....	92.95	90.95	83.55	81.95	91.43	89.83	82.03	80.43

Table VII—Luminous Ceilings

LIGHTING SYSTEMS →		1	2	3
		Rapid Start 1-F40 T12/RS 120V 4' Long Metal Louvers	Rapid Start 1-F40 T12/RS 120V 4' Long Vinyl Plastic	Rapid Start 1-F40 T12/RS 120V 4' Long Acrylic Plastic
<b>BASIC DATA</b>				
1	Rated initial lamp lumens per lamp (Standard cool white)	2,500	2,500	2,500
2	Lamp life	7,500	7,500	7,500
3	Average watts per lamp	39	39	39
4	Watts per lamp (includes ballast watts)	50	50	50
5	Coefficient of utilization	.53	.66	.66
6	Maintenance factor	.75	.75	.75
7	Effective maintained lumens per square foot <small>(ITEMS 1 X 5 X 4) 10,000 SQ. FT.</small>	100	100	100
8	Relative number of lamps needed for equal maintained FC	1,006	808	808
<b>INITIAL COSTS</b>				
9	Net cost per square foot	2.60	1.50	3.65
10	Installation and distribution cost per square foot	.85	.75	.85
11	Net initial lamp cost per square foot including tax	.09	.07	.07
12	Total initial cost per square foot	3.54	2.32	4.57

naire. Suspended luminaires, recessed luminaires, and overall luminous ceilings vary in cost as shown by Tables V, VI, and VII.

To produce higher lighting levels in commercial areas, the problem of noise has to be considered in certain applications that may be costly to overcome. The high output ballasts are rated at a higher noise level and are used with light sources having a higher output, thus limiting the area in which this type of fluorescent light source can be applied. Economic figures may show that the high output lamp may be lower in initial cost, but the re-

quirements of quietness will rule out such an application. Locating the ballasts remotely will overcome the noise from the ballast, but the additional cost of doing this more than offsets the savings over the lower output fluorescent lamp.

Higher lighting levels produce more heat from the ballasts and lamps, increasing the initial cost as well as the operating cost. Since the heat gain is in direct proportion to the wattage input of the lighting system, air conditioning must be designed to cool the circulating air. At the same time when heat is needed, as in the winter months,

this additional wattage can provide a portion of the heating requirements. The increased tons of air conditioning required for each additional load in watts per sq ft are summarized in "Table VIII-Increased Air Condition Tonnage."

The increased tonnage and cost require creative application of integrating the air conditioning and lighting. Progress is being made in removing the heat caused by the ballast through exhaust ducts that bleed off the air in the ceiling cavity or connect directly to the lighting troffer. Both these methods are being used, and preliminary figures indicate a reduction in air condition tonnage, as well as in the overall cost of lighting, air conditioning, and heating. In making a lighting system cost analysis, such as a 50-fc versus a 100-fc system, costs for additional air conditioning required for the 100-fc system should be included as a lighting system cost.

The demand for higher lighting levels has increased year by year, and the scientific studies by the Illuminating Engineering Society have proven the desirability of these higher lighting levels. Economic factors have governed the growth of this increase. Scientific progress in light sources together with creative design in application will by virtue of the value received make it possible to have higher lighting levels. Designers have a challenge to meet in reducing the overall cost, investment, and operating costs.

Table VIII—Increased Air Condition Tonnage Based on 1000 Square Feet of Floor Area, for Comparative Figures

Watts per Sq. Ft.	Tons	Cost*
3.0	.85	\$850.00
3.5	.99	990.00
4.0	1.13	1,130.00
4.5	1.27	1,270.00
5.0	1.41	1,410.00
5.5	1.56	1,560.00
6.0	1.70	1,700.00
6.5	1.84	1,840.00
7.0	1.98	1,980.00

\*Cost based on \$1,000.00 per ton.

# Better Lighting Maintenance

As lighting levels increase, better shielding and more light control devices are required to maintain visual comfort and lighting quality. These, in turn, further complicate lighting maintenance. Light loss due to lack of maintenance is already costly, will become even more so with higher levels of illumination.

By Carl M. Holden,\* Chairman, IES Lighting Maintenance Committee

\* Commercial Engineering Dept., Champion Lamp Works, Lynn, Mass.

LIKE horsepower in automobiles, illumination levels for offices, factories and stores have shown a steady increase since the value of good lighting first began to be recognized back in the early 1900's. The recently announced new IES Recommended Levels of Illumination, covering a wide variety of industrial and commercial seeing tasks, range generally from 50 to 250 footcandles, as compared to the 1920 levels of 5 to 10 footcandles.

There are two important differences in these recent lighting recommendations, compared with those previously in use as industry standards. The new recommended lighting levels refer to a *minimum* illumination "on the visual task" at all times, *any* place in the room where light is required for the visual tasks performed there. Past recommendations referred to "average illumination" in a room, which was the average of foot-candle values measured from wall-to-wall. Also, the maintenance factor employed in calculating the depreciation due to dirt, lamp deterioration, and existing maintenance features is no longer an "average" loss, but a "maximum", so that "minimum" illumination levels can be more accurately determined. Put these factors all together and they mean a higher

investment in lighting equipment and installation cost to adequately light our modern environment.

A logical question at this time would be "Will industry accept these new lighting recommendations?" The answer is "yes," and the reason is an economically sound one. With the high cost of labor and machinery, good lighting represents a relatively small investment, when you consider its value as a production tool. Business management finds that it is getting its money's worth in more efficient production, reduced waste, reduced labor turnover, and an improvement in employee morale and pride.

Due to improvements in lamp efficiency, the development of new high output light sources, and the availability of data to justify the use of more efficient luminaire types, the cost to install up to date lighting has not shown the increase that the illumination levels would indicate.

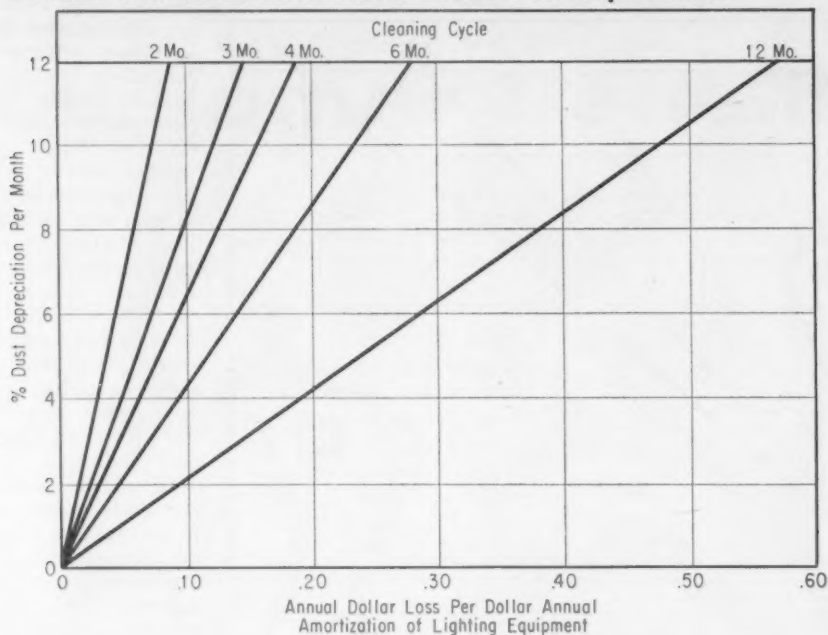
Many studies have shown the advantage of using semi-commercial type luminaires in industrial areas instead of the previously popular so-called bath-tub type of industrial unit. These new open-top luminaires that allow an upward component of light have proved in practice to be more efficient, and to suffer less from the loss of light

normally associated with dirty industrial locations. There will be more equipment and new lighting techniques, as time goes on, all presenting new problems and requiring better maintenance and more frequent cleaning.

The planning of new lighting installations that will produce the new higher lighting levels will require more thought and engineering to avoid the pitfalls of glare and visual discomfort. New light sources which produce up to 2.5 times the light output of the more common types of light sources can be used to keep the number of luminaires to a minimum. But with these new light sources, shielding will be a must. Slotted openings in the top of industrial luminaires have proven to be helpful in retarding the light loss due to the collection of dirt and dust on lamps and reflector surfaces. The upward component of light from these open top luminaires also lights the ceiling softly and helps to reduce the harshness of light that has generally been associated with brightly lighted industrial reflectors of the closed-top type as viewed against the dark, unlighted ceiling. With brighter lamps and higher lighting levels, improved shielding and diffusing devices must be used to improve the lighting quality. All such



**CHART I—Annual Investment Loss Due to Dust Depreciation.**



devices further complicate lighting maintenance, and make the cleaning and relamping of the luminaires more difficult. There are many labor saving devices and luminaire design techniques, however, that can be used to further simplify relamping and cleaning operations. A little thought about such features, when the luminaires are designed, including method of mounting and accessibility, can contribute greatly to the speed and ease of maintenance, and help to streamline an otherwise burdensome task. Also, maintenance should be considered and planned for at the time the lighting system is designed, and when the units are purchased, in determining luminaire configurations, finishes, auxiliary equipment and other similar features. Such consideration can save many dollars throughout the life of a lighting installation. Money saved in the initial purchase of lighting equipment which does not incorporate such features could very well mean many dollars wasted in keeping the lighting system in proper operating condition.

Any lighting installation loses efficiency in three ways. Lamp depreciation, accumulation of dirt and dust on the luminaires and lamps, and gradual deterioration of the reflecting surfaces in the room it-

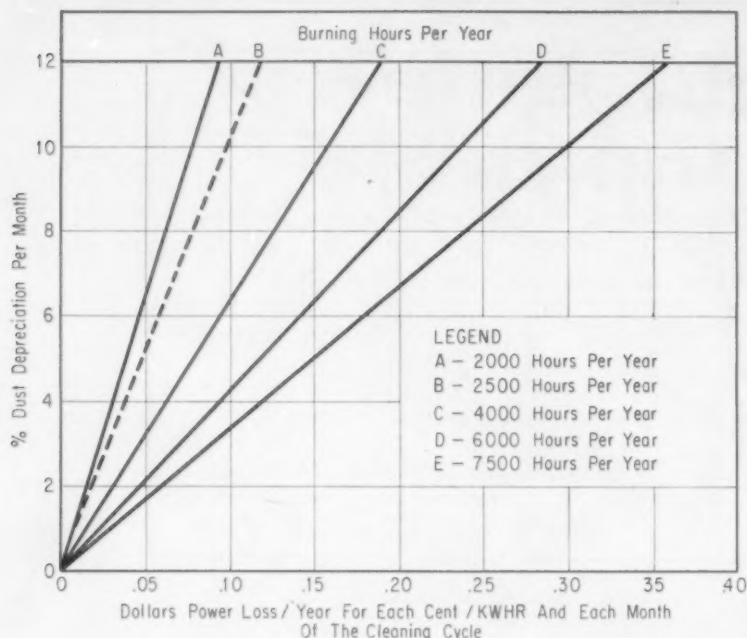
self, all contribute to the loss of light, and to the gradual decline of the level of illumination. The first factor, lamp depreciation, is unavoidable. But the other two factors can be controlled, or minimized, by good building and plant maintenance. Lighting installations that lose up to 50% of their designed light output due to lack of maintenance are not uncommon. Any good plant engineer would overhaul any piece of machinery when its efficiency dropped to only a fraction of that amount, and would probably replace it entirely if its efficiency dropped as much as 50%. Perhaps it is the lack of knowledge of how much light is actually being wasted that causes them to ignore a low efficiency lighting system.

The rate of dirt accumulation will vary between any two lighting installations, and even between different areas of the same installation. Before any cost analysis can be made to justify a cleaning or maintenance program, it is first necessary to know the rate at which the illumination is depreciating. This light waste can be determined by a simple procedure, which consists of two sets of footcandle measurements and a division problem. The procedure is to allow the luminaires to collect dust for a specified period of time following

the last cleaning. At this time, make a set of footcandle measurements in the area and average them. Next, have the luminaires and lamps cleaned. Following this cleaning, make another set of footcandle measurements, in the same location as for the first set of measurements, and average these readings. The difference in the two sets of readings will show the light loss resulting from the dirt and dust accumulation.

As an example, before cleaning, the average illumination is found to be 30 footcandles. After cleaning, the second set of readings indicates an average of 50 footcandles. This means the light loss due to dirt accumulation amounts to  $(50 - 30)/50$ , or 40%. If the time period was ten months between the two cleanings, the average rate of light depreciation is  $40\%/10$ , or 4% per month. When this rate of depreciation has been determined, Charts I and II presented with this article may be used to quickly determine the cost of the light being wasted per year in electricity and amortization expense, due to the lack of adequate maintenance. Knowing this, it is a simple matter to compare the cleaning cost against the advantages and savings for a variety of cleaning schedules. The most eco-

**CHART II—Annual Cost of Power Loss Due to Dust Depreciation**



nomical schedule can be adopted.

A systematic measurement of footcandle values in an area may also be plotted on a chart to determine the rate of depreciation of a lighting system. This may have some bearing in the scheduling of cleaning areas where windows are open a great deal of the time during summer months. Chances are that light depreciation will be greater during this period. Once the rate of light depreciation for such areas is established, the cleaning cycles can be properly scheduled to compensate for rapid light loss due to fast accumulation of dirt.

As an illustration of how to appraise the cost of light wasted due to the accumulation of dirt, the following example is given. Assume a large office area in which the rate of dust depreciation is found to be 4% per month, using the procedure already outlined. Further assume that the lighting system investment for this office area is \$50,000, and that it is being amortized over a 10-year period at \$5,000 per year. The power rate is 2 cents per kwhr, and the lights are on 48 hours a week, or 2500 hours a year. The installation consists of 1000 commercial-type luminaires, each equipped with two 40-watt lamps and ballast, consuming 100 watts per luminaire.

Chart I may be used to determine the annual cost of light loss inherent in the capital invested in the lighting system. On the chart, move horizontally across the 4% dust depreciation per month line until it intersects the 12-month cleaning cycle line, nearest cleaning cycle on which the 4% rate of depreciation was determined. The chart shows a loss of 19 cents per year, on each dollar of its annual lighting investment, \$5,000 in this case. This amounts to \$950 worth of light lost, or light paid for but not received, based on amortization of the lighting investment only.

Next, consider electric energy paid for in terms of light lost due to dust depreciation. Chart II provides a simple means of calculating this annual loss in dollars. By following across the 4% per month dust depreciation rate on this chart until it intersects the 2500 hour per year operation line (dash line), a value of 3.8 cents is indicated. This represents the waste of electricity per year for each cent per kwhr power rate, and each month of the cleaning cycle, for each 100 watts of lighting load in the lighting installation. To find the total power being wasted, it is then necessary to multiply the 3.8 cents by 2 cents for the power rate. This results in 7.6 cents, which should be multiplied

by 12 for the existing monthly cleaning cycle, or 91.2 cents. Since the total lighting load in the area is 100,000 watts, or 1000 100-watt luminaires, the 91.2 cents is multiplied by 1,000, which shows the annual power waste alone to be \$912.00. The total value of the lighting system being wasted by dust depreciation, by cleaning only once a year, amounts to \$950 plus \$912, or \$1,862 per year, for investment and power losses only.

Similar calculation procedures can be made for more frequent cleaning intervals, using these two charts, which will show savings in these losses only. Against these savings must be balanced the added costs for cleaning at the more frequent intervals.

In addition to the actual dollars and cents waste that are confined to the lighting installation, due to dirt accumulation only, there are the losses in production, waste of material due to rejects, and waste of employee labor and efficiency due to the inability to see quickly and accurately due to this loss of light. This, naturally, is more difficult to appraise in dollars and cents. Considerable material has been published recently, however, which indicates considerable increase in production, safety, and savings in materials with less rejects, attributed specifically to higher lighting levels. These have been specific case studies. These savings have been enough to justify many hundreds of footcandles. Conversely, light loss due to inadequate lighting maintenance wastes manpower and materials, and increases labor turnover. These all become plus factors in the justification of better lighting maintenance.

It is evident that the burden of proof of the losses of light due to poorly maintained or inadequate lighting rests with the lighting industry. There have been a few studies made along this line, but they have been so few and far apart that their value has been lost in the maze of new lighting developments that are introduced each year. The Lighting Maintenance Committee of the Illuminating Engineering Society is currently embarking on a program to develop just such proof. A wealth of data and new information must be collected and appraised. But when this task is completed, the basis for a sound evaluation of lighting maintenance will be available.

## Higher Lighting Levels Mean Still More

# Customer Benefits

Lighting is now entering a new era. It is destined to play an ever increasing role in the lives and activities of people everywhere. Its inherent benefits will expand, as lighting levels increase, and as new and advancing technology is applied.

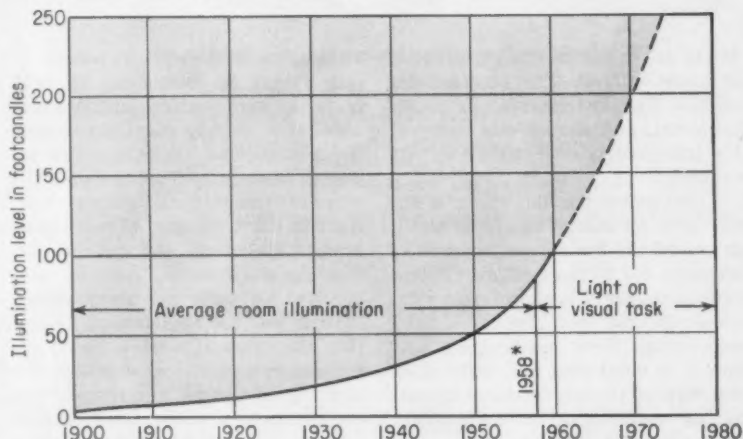
By Berlon C. Cooper, Associate Editor

**T**HE new IES lighting levels are already here and in use, and for many very good reasons. Call it advanced lighting practice if you like. But these new and so-called "higher" lighting levels already exist, in a wide range and variety of lighting installations, which have been made over the past four or five years. These installations have been made because they pay dividends to the lighting customers who have invested in them, dividends in the form of customer benefits.

Many cautious but far-sighted businessmen, after looking at the facts about light, coldly and analytically, have already bought and had installed modern lighting systems which more than meet the new IES recommended lighting levels. And this has been done for the simple reason that these customers recognized that higher lighting levels, which provided greater seeing accuracy and more comfortable seeing would pay dividends—would be a sound investment.

The former IES recommended levels of illumination, with which the new IES lighting levels are being compared, were based on various IES-ASA Recommended Practices, approved and adopted on differing dates over a period of several years. These older recommendations were outdated. Current lighting practice has been to install lighting levels which generally exceeded the older values. Thus, the Blackwell research provided a new scientific and valid basis for the new IES recommended lighting levels, and an opportunity to up-date the old recommendations. The new recommendations are now more in line with the advanced lighting

CHART I—Growth of Lighting Levels



\*IES adopts new "Recommended Levels of Illumination," based on footcandles on the visual task.

practice which had already developed. The history of the growth of lighting levels is shown in "Chart I—Growth of Lighting Levels."

The term "higher lighting levels" is probably well understood within the lighting profession, but it carries a psychological connotation which is misleading to the lighting prospect. Some other designation might well be more appropriate, such as the "new IES lighting levels," or "current lighting practice."

### Value of Electric Lighting

Historically, electric lighting has played a major role in the industrial and commercial development of the United States. Electric lighting has made possible our 20th Century continuous, round-the-clock, 24-hour-a-day economy. Before the advent of electric lighting, ours was

an agricultural daylight economy. Thus, viewed broadly from this standpoint, our national economy has achieved its present status of the world's largest through the exploitation and use of electric lighting.

Dr. H. L. Logan, internationally known for his research on light and vision, has defined the value of lighting most aptly. He has stated "The degree to which our civilization is dependent upon electric lighting is fantastic to the unobservant. It penetrates every nook and cranny of modern living, from the delivery room where the new life comes into the world, the nursery where it spends its first few days, the home in which it grows, the school in which it is taught, the roads it has to travel at night, the office, the institution or factory it

## TABLE I—Industrial Lighting Benefits

Higher lighting levels\* in factories will provide these benefits:

- Higher productivity (more output per man-hour).
- Increased production (more goods produced).
- Greater accuracy (better workmanship).
- Greater seeing ease (employees see faster).
- Improved product quality (less rejects).
- Less waste (higher materials utilization).
- Greater safety (less accidents).
- Improved employee morale (better health).
- Better work supervision.
- Better housekeeping.
- Better employee relations.
- Better public relations.

\* Based on new IES Recommended Levels of Illumination, and lighting quality considerations.



**POWER GROOVE** fluorescent lamps in open top industrial reflectors provide 250 footcandles in this grinding area of a tool company. Note absence of sharp contrasts in brightness ratios. This new lighting resulted in 10% production increase, complete elimination of errors due to misreading of micrometers, a 50% decrease in minor accidents, a rise in employee morale, and complete flexibility in machine location without having to rearrange the lighting.

works in, to the mortuary where it is finally laid out. This omnipresent electric light determines our entertainment, and shapes our customs. Its influence is everywhere in our country."

Light makes possible sight. Without light we cannot see. And sight, as one of the five senses, reportedly accounts for 87% of all mental impressions. Light is therefore a vital necessity for our livelihood and well-being. How much light, and how it is controlled and utilized, is the task of the professional illuminating engineer, or his counterpart in commercial practice.

Light makes vision possible, but the quantity of light, and how it is controlled (quality considerations), determines how fast we see, and

the degree of comfort in seeing.

Daylight is inconstant in both quantity and quality, and is available only during daylight hours. Thus American commerce and industry has accepted and adopted the more reliable electric lighting. This lighting is available at all times, around the clock, and can be custom designed as to quantity and quality, for each and every seeing task, or end use application. Therefore the value of electric light, appraised in terms of what it does for lighting customers, and thereby for the nation as a whole, takes on new stature in the light of these broad considerations.

### Lighting Appraisal

Electric lighting is today a way

of life. It is generally taken for granted. Therefore, buyers of lighting systems can well afford to make hard-boiled and critical appraisals of proposed lighting systems, and usually do. The real problem from the lighting industry's viewpoint, is the fact that it is a difficult matter to properly evaluate the many lighting benefits which a proposed lighting system may provide. This is a difficult problem even for the lighting salesman, or lighting engineer. And since this is so, how can the prospect be expected to make a valid appraisal? Without proper guidance, how valid are his appraisals?

Lighting systems cost money. And systems which will provide higher lighting levels are expected to cost even more. Thus, it is only

## TABLE II—Office Lighting Benefits

Higher lighting levels\* in offices will provide these benefits:

- Higher productivity (more output per man-hour).
- Faster completion of work.
- Greater accuracy (fewer errors).
- Improved vision( employees see faster).
- Less eye-strain (fewer headaches).
- Less absenteeism (better health).
- Improved employee morale.
- Better environment (improved appearance).
- Better employee relations (good place to work).
- Better public relations (prestige value).

\* Based on new IES Recommended Levels of Illumination, and lighting quality considerations.



**4-FT SQ** fluorescent luminaires recessed in ceiling in an alternate panel arrangement lights this modern open office area to a level of 90 footcandles. Note that desk tops, floors, columns and partitions are light in finish, and aid in creating a comfortable visual environment.



### TABLE III—School Lighting Benefits

Higher lighting levels\* in schools will provide these benefits:

- Students see faster (adequate illumination).
- Greater seeing ease (adequate illumination).
- More accurate seeing (adequate illumination).
- Students learn faster (see better).
- Better student posture (uniform lighting, no shadows).
- Eyesight conservation (adequate illumination).
- Better health (no eye-strain, or headaches).
- Better space utilization (uniform lighting).
- Better teacher supervision (no dark areas).
- Better housekeeping.

\* Based on new IES Recommended Levels of Illumination, and lighting quality considerations.

### TABLE IV—Store Lighting Benefits

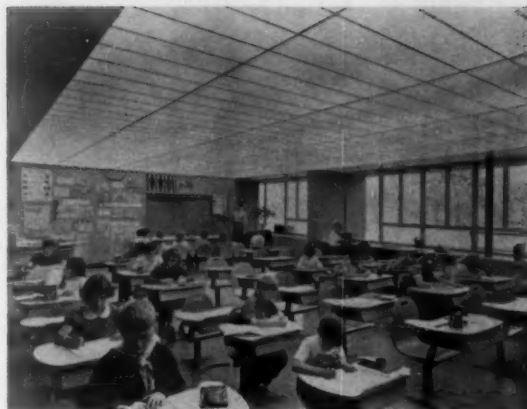
Higher lighting levels\* in stores will provide these benefits:

- Increased sales (more customers).
- More customers (light attracts people).
- Faster appraisal (customers see better).
- More items sold (special items highlighted).
- Satisfied customers.
- Fewer returns (better appraisal).
- Improved appearance (light enhances environment).
- Better environment (light creates cheerful atmosphere).
- Improved employee morale (less eye-strain, less headaches).
- Better public relations (customer satisfaction).

\* Based on new IES Recommended Levels of Illumination, and lighting quality considerations.



**BASIC PRINCIPLES** of store lighting are well illustrated by the many techniques used to light this shoe store. Displays are highlighted by incandescent reflector spots, surface-mounted on walls and recessed in the ceiling. Recessed fluorescent ceiling panels flood the entire sales area with diffused uniform illumination. Fluorescent lamps in the wall coves, which extend around the entire room, light the perimeter ceiling softly, to provide uniform brightness throughout the area. Pendant indirect incandescent units, suspended from the center of the ceiling, light the center ceiling area, and add a decorative touch.



**PLASTIC LOUVER** panels below fluorescent lamps in ceiling cavity form a luminous panel ceiling in this classroom, is highly efficient, low in brightness, provides shadow-free illumination, and greatest possible "seeability" and visual comfort for the students. Luminous ceiling treatment lowers brightness contrast ratio with outdoor area, as photo illustrates.

### TABLE V—Home Lighting Benefits

Higher lighting levels\* and greater lighting flexibility in homes will provide these benefits:

- Better lighting for every seeing task.
- Correct illumination for each activity.
- More speed and accuracy in food preparation and cooking.
- More comfort in reading, studying, etc.
- Greater utilization of floor space, and freedom in furniture arrangements.
- More attractive homes.
- Push button availability of various "mood" effects, and decorative treatments.
- Happier home life, better health, and improved morale.

\* Based on new IES Recommended Levels of Illumination, and lighting quality considerations.



**VARIETY** of home lighting techniques are illustrated in this picture. (l to r): Wall case is self-illuminated, with translucent top which filters light upward; Spotlight on ceiling lights picture on wall; Floor lamp in corner provides light for easy chair; Table lamp in foreground; Wall valance lights rear wall and two windows; Wall bracket lamp lights desk; Recessed spots in ceiling light planter behind desk; Floor lamp in foreground lights ceiling; Torchieres light ceiling and wall at right; Bracket on wall at right lights wall and ceiling, and ceiling recessed incandescent lights table at right. Flexible control arrangement permit a wide variety of lighting effects to suit any mood or occasion.

**TABLE VI—Basic Factors for Customer Appraisal of Cost of Lighting Versus Benefits**

(On new construction, use this table to compare proposed lighting systems of different levels of illumination and quality. On relighting projects, use this table to compare the proposed new lighting system with the existing lighting system.)

Lighting System Costs*	Dollars	Value of Lighting Benefits to Customer	Dollars
<b>Initial Cost</b>		<b>Direct Benefits from Lighting (Annual)</b>	
1. Lighting system (installed cost)	-----	17. Value of goods (or services) produced annually	-----
2. Electrical wiring system for lighting only, (installed cost)	-----	18. Efficiency increase, attributable to better lighting (%)	-----
3. Air conditioning system, (pro rata cost for capacity required to handle lighting load only)	-----	19. Annual value of efficiency increase (item 17 x item 18)	-----
4. Other building costs, or savings, attributable to the lighting system installation	-----	20. Decrease in product rejects, under better lighting	-----
5. Total lighting system cost (items 1, 2, 3, 4)	-----	21. Annual savings (labor and materials) for decrease in rejects (item 20 x unit cost of labor and materials)	-----
6. Amortization period (years)	-----	22. Annual savings due to reduction in accidents with better lighting	-----
<b>Annual Operating Cost</b>		23. Other direct savings in direct benefits	-----
7. Annual energy cost (at estimated $\text{\$/kwhr}$ )	-----	24. Total value of annual direct benefits (items 19, 21, 22, 23)	-----
8. Annual cost of lamps (for replacement)	-----	<b>Indirect Benefits from Better Lighting (Estimated Annual Value)</b>	
9. Annual lighting maintenance cost (repair, plus labor for cleaning and relamping)	-----	25. Reduced labor turnover	-----
10. Total annual operating cost (items 7, 8, 9)	-----	26. Better work environment (improved employee morale)	-----
11. Annual amortization cost (principal plus interest)	-----	27. Better housekeeping (employee reaction)	-----
12. Total annual owning cost (items 5, 10, 11)	-----	28. Better public relations (prestige value)	-----
13. Number of employees	-----	29. Other indirect benefits	-----
14. Annual cost of lighting, per employee (item 12 divided by item 13)	-----	30. Total annual value of indirect benefits (items 25, 26, 27, 28, 29)	-----
15. Total annual payroll	-----	31. Total annual value of all lighting benefits (items 24, 30)	-----
16. Annual lighting cost per employee, as a percentage of annual payroll (item 14 divided by item 15)	-----	32. Annual value of lighting, per employee (item 31 divided by item 13)	-----
		33. Return on lighting investment (item 32 minus item 14 divided by item 14) (%)	-----

\* For detailed procedure for estimating the cost of a lighting system, see "Fundamentals of Lighting Cost Analysis," by A. C. Barr and C. L. Amick, *Illuminating Engineering*, Sept. 1951.

logical that customer benefits must be measured in dollars also, in order to provide a common denominator between costs and benefits. This means that appraisals will take the form of an economic analysis. In such analysis, it is relatively easy to determine the cost of a lighting system, either existing or proposed. It is not so easy, however, to determine the value of the benefits to be derived from the system. Only the lighting customer is qualified to place a monetary value on such benefits, since he, and only he, can relate these benefits to his own business operation in terms of dollars.

In view of these considerations, an effort has been made here to point out only, and to list, some of the benefits which may be expected. Lighting benefits vary between one type of business activity, and another, although certain types of benefits will obtain for each type of business. Thus, separate listings of benefits are made for industrial, office, store, school, and the home. These are presented in tables I to V, inclusive. These lists are not considered all inclusive—lighting prospects will undoubtedly think of still other benefits as they begin to evaluate lighting as it applies to their own specific lighting requirements.

Lighting prospects may be classified as either of two types. One type, is the prospect that is build-

ing a new structure, and the other is the relighting prospect that already has a lighting system, but is considering a new one. In the case of the prospect who is building a new structure, he is interested in comparing one type and quality lighting system with another, such as a 50-footcandle system versus a 100-footcandle system. In the case of a relighting prospect, his interest is in a comparison of his existing system with a new and better system. Table VI, shown above, has been prepared in an effort to simplify preparation of data for such comparisons. It is suggested that lighting prospects develop comparative data on lighting systems under analysis with the help and cooperation of their electrical contractor, or consulting engineer, as these industry specialists can provide the needed initial cost and installation data, and annual operating costs.

In the past, lighting system design has been based primarily on illumination levels only for visual performance. More recently the factor of visual comfort has been used to some extent. And now, with lighting levels being increased, the factor of aesthetic pleasantness is receiving more attention. Certainly this is an important factor with considerable merit for the lighting customer. But its value is definitely something that only the lighting customer can determine.

### Future of Lighting

Electric lighting is destined to play an ever broadening role in our lives and activities. It is already facing much broader horizons, functions well beyond those of utility, convenience and safety.

Electric lighting is now being considered in a much broader sense. Architects are now considering light as an element of design. Also, they are beginning to realize that only through intelligent use of light can the design features of their structures be portrayed to best advantage. Several architects have recently featured light in this manner, and the trend is growing. The full possibilities, however, of what can actually be accomplished with light remain to be explored. Buildings using light as a design element to date have involved static, or fixed, lighting effects. Still to be explored is the broad field of light in color. Then there is the whole field of variations in intensities of light, both in "white" and in color, for interesting and dynamic changes in mood and environment. These fields offer endless possibilities.

The results can be highly exciting and aesthetically pleasing. Add these possibilities to the functional and utilitarian benefits of today's modern lighting, and the future of lighting is one of expanding growth and service to people everywhere.

# Keeping Ahead of Demand

Recognizing the fact that tenant electrical requirements are doubling every decade, management of old Cleveland office building triples capacity of existing distribution system in major modernization move. Installation was by Merrill Electric Co.

**C**ONTINUOUS MODERNIZATION is the theme subscribed to by Douglas F. Schofield, manager of the 56-year-old 14-floor Schofield Building in Cleveland, only recently having invested in a new service entrance, a new bus duct riser system, new circuit breaker distribution panels, new branch circuiting to tenant offices and stores, and new fluorescent lighting in public lobbies and corridors.

This modernization program is no "stop-gap" expedient. Rather, it is designed to "play leap-frog" over present electrical loads and insure the future." With 15 watts/sq-ft now available over three acres of rentable floor area, this program is proving effective in attracting new tenants as well as holding old ones, in spite of the fact that tough renting competition now exists in downtown Cleveland as a result of several new commercial buildings in the immediate vicinity.

In greater detail, the present modernization program necessitated construction of a new utility vault, increasing transformer capacity from 450 to 750 kva, and

providing both space and bus facilities to re-increase capacity to 1500-kva when required. It also included a modern metal-enclosed distribution center in the basement, including a 3000-amp Pringle switch with lug limiters and indicating ammeters for each phase. This new installation replaces a live-front obsolescent relic of the past (see accompanying illustration).

To connect vault buses with this new basement distribution center, flexible armored cables were supported on trapeze racks, hangers being secured to flanges of overhead beams by means of C-clamps, as pictured. This distribution medium was selected, rather than rigid conduit or bus duct, due to existing thick bearing walls, twisting corridors, changing ceiling heights and the prevalence of countless physical and other-service facilities. Furthermore, since no adequate vertical shaft existed between the basement and the second-floor electric closet, armored cable was likewise used between these two terminals, being snaked upwards through small, unaligned



**DISTRIBUTION CENTER**, with rear access panel opened, shows bus structure related to 3000-amp service entrance and main switch. Armored cables from transformer vault are seen above head of manager Schofield, while flexible cables rising to base of busduct riser system are noted at upper right. Present service capacity is three times greater than system immediately preceding it and ten times greater than the original system of 1902.

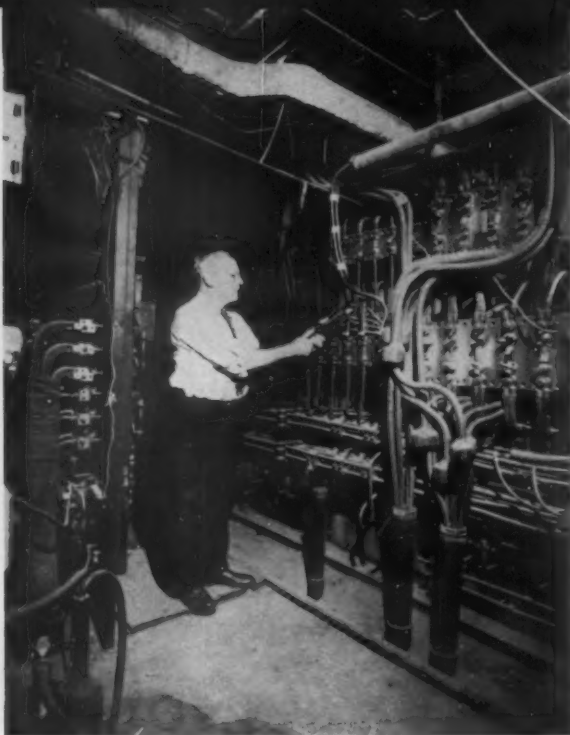
passageways and openings discovered behind a stairwell wall.

## Vertical Busduct Distribution

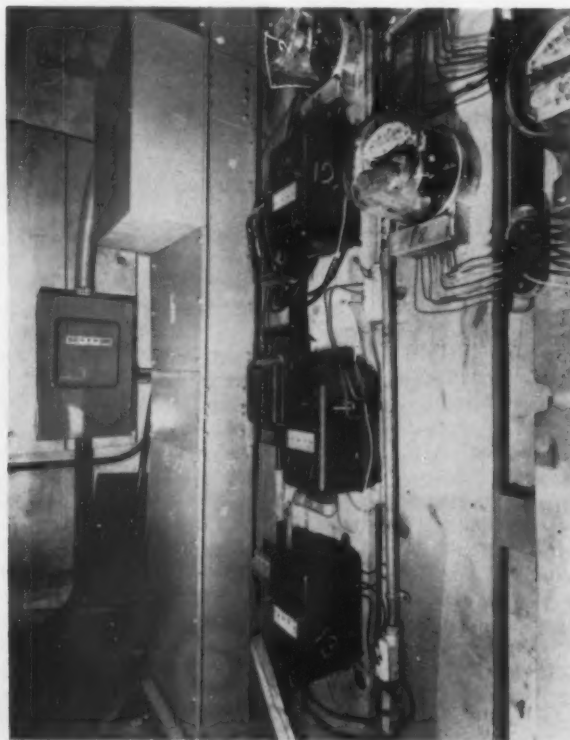
Since electric closets on upper floors were vertically tiered, it was decided to install a 2500-amp 4-bar enclosed busduct from the 2nd to the 10th floor, reducing the capacity of the riser to 1000 amps at that point, but continuing the busduct medium to the top of the building.

This installation materially exceeds present tenant demands, for it was sized by arbitrarily doubling present meter consumptions, then increasing it still further to provide for eventual air-conditioning of all offices in the building. At present, loads are balanced evenly on the three phases and, since capacitors are being installed in conjunction with the connection of all large motors, power factor is expected to remain fairly high.

As to local distribution on the various floors, old cartridge- and wire-fuse live-front panels are now being progressively replaced by



**CHIEF ENGINEER** Frank J. Bowe uses clamp-on meter to check phase loading of old live distribution board in basement of 56-year-old building. Assembling complete, accurate, long-term modernization data was possible because of a detailed filing system and the memory of this engineer.



**WORK-IN-PROGRESS** view, taken in typical upper-floor electrical closet, shows enclosed 4-bar busduct riser, floor take-off tap box, plus an assortment of old submeters which were later regrouped and connected to modern circuit-breaker panel. Capacity of system is now equivalent to 15 watts per sq ft.

enclosed breaker panels; submeters are being recalibrated; minimum size of branch circuiting to tenant premises is being increased from No. 14 to No. 10; capacities of switches and breakers are being raised (through replacement) to coincide with new circuit capacities; breakers are being plainly identified as to capacity and the space or equipment they control; and tenant wiring is being simplified, rerouted and consolidated so that electrical control can be centered at one location (rather than at four or five as previously) for each tenant.

Since the Schofield Building has been owned and operated by the same family interests since its construction in 1902, and since the electrical system has been the "baby" of the same chief electrician for 51 years, fairly complete records are available concerning previous costs and modernization work.

For example, the building cost \$767,000 when built. Of this amount, \$38,000 (5%) was for an "electrical system" that included a steam generating plant to produce 110/220-volt ac, 4 mains having a total capacity of 900 amps, a 100-amp distribution panel on each floor and 2-wire branch circuits radiating to individual offices.

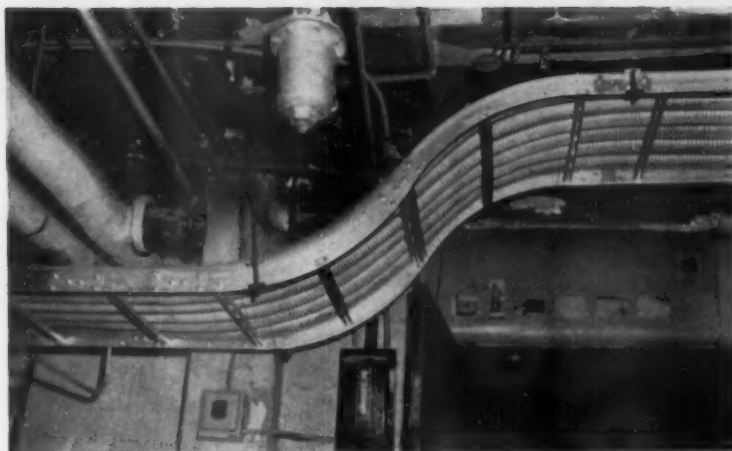
Compared to these early figures, it is interesting to note that the present busduct installation plus work related to the installation of 4-wire, ac service facilities cost over \$60,000, while new transformers and vault construction cost the local utility company over \$95,000. These two items alone indicate that recent electrical modernization has cost four to five-times more than the complete original system did at the turn of the century, while costs of other intervening "modernization" programs raise this ratio still higher.

#### **System Capacity Increased 1000%**

Checking the original plans further reveals the fact that the first electrical installation provided about 1½ watts/sq ft, or about 2½ amps per room. This is only a tenth of today's system capacity and seems somewhat ridiculous when compared to present standards, yet it was considered "adequate" half a century ago when tenants used current just for lighting—and not *much* lighting, at that.

By 1915, the system was experiencing its first need for "modern-





**FLEXIBLE ARMORED CABLES** supported by ladder racks were used to carry utility service from vault to basement distribution center. Flexibility of feeders plus variety of ladder sections simplified routing through twisting corridors, under beams and pipes, over doorways and through thick bearing walls. Installation is part of latest move in building management's continuous modernization effort.



**CABLE RACKS** are supported by means of hangar rods and C-clamps secured to lower flanges of overhead structural beams.

ization." And, when a worn-out boiler plus sharp coal- and labor-rate increases forced an electrical re-evaluation, it was deemed expedient to switch to utility-supplied dc and replace the steam-driven freight elevator with an electric one.

This failed to solve the complete problem, for some tenants (doctors and dentists primarily) could not replace specialized ac equipment during that World War I period. This necessitated the addition of a second, smaller ac service from the outside. Moreover, with sub-metering coming into vogue and calibration of meters being somewhat neglected, wide discrepancies in tenant electrical charges resulted in considerable annoyance to all parties concerned.

By 1940, all meters had been recalibrated, resulting in an interval of peace—but then some of the tenants heard about the wonders of air conditioning and 3-phase motors.

This led to another stop-gap service entrance, more meters and more wiring that "just grew like Topsy." At the same time, still in the interest of "modernization," the four original hydraulic passenger elevators were replaced with multi-voltage floor-leveling units operated by ac/dc m-g sets, with another new cable-in-conduit riser being carried up the freight hatch and through attic space to the new elevator penthouse.

With growing loads, the manage-

ment then became acquainted with the mysteries of utility demand charges—which were indirect blessings insofar as they prompted a system survey and eventually dictated the installation of capacitors in the penthouse to correct the building's power factor. That move (in 1949) was a pioneering step in the Cleveland area and, since the capacitors quickly paid for themselves through savings and were duly publicized, the move inaugurated a general adoption of pf-boosting equipment in similarly affected buildings throughout the city.

#### **Modernization Tied to DC-AC Switch**

About that same time, the local utility standardized upon 4-wire 110/208-volt ac for general downtown utilization, rather than upon dc service, as formerly provided. So, again in the interest of "modernization," transformers rated for 450 kva were installed in the original coal bin of the Schofield Building—a move designed to "positively insure future capacity."

Five years ago, however, even this latest source of supply became inadequate. Demand charges started climbing again. Main fuses popped regularly at noon during hot summer days. Passenger elevators (inadvertently connected to the 3-phase section of the main distribution board) shut down when an air conditioning unit in one of the stores blew a fuse.

This called for more stop-gap measures, such as installing fans in the vault for forced-cooling of transformers, temporarily by-passing inadequate switches, and requesting some of the larger tenants not to use their air conditioners.

That condition dictated another extensive re-evaluation of the electrical system and it showed that the system was overloaded from top to bottom, a condition caused partially by the fact that tenant air conditioners had jumped from 25 units to over 100 between 1952 and '54 (and they have doubled again between '54 and the present).

This returns us to the beginning of this discussion, for it was existing conditions in 1954 that convinced Schofield management that "stop-gap measures are compromises that cannot be tolerated."

This case-history has a definite objective: to emphasize the fact that electrical consumption in all types of occupancies and fields of endeavor is continuously increasing. Tenants generally expect and demand electrical capacity to supply their requirements—or their whims.

This focuses attention on a serious problem and a clear alternative: old buildings must "play leap-frog over present electrical loads" and subscribe to intelligent far-reaching modernization programs, or they can ignore their inadequacies and face losses of tenants, income and, eventually, insolvency. There is no alternative!

# Billing Contract Additions And Changes

How to bill change-orders or "extras" to get a fair return and still maintain customer good will.

By Ray Ashley

Research and Consulting Engineer, Oak Park, Ill.

IF A CONTRACTOR can collect for his "extra" work by just sending a bill without explanation or elaboration, fine. However, there are times when he must be prepared to substantiate his billing. Such is the condition on which the following discussion is based. This article is, in effect, a response to requests from electrical contractors for something to help stabilize practices. It is not an attempt to prescribe, or recommend that any contractor establish, any fixed rules for figuring and billing additions and changes. Neither is the author trying to tell any contractor to "stick his neck out" by supplying a lot of unnecessary data along with his billing. It is designed to be more or less a guide-post which can be adapted to individual billing problems. If a contractor is to operate with impunity, his dealings must be flexible and adaptable to particular cases.

As used throughout this discussion, the term "extra" denotes the long established trade-meaning of "additions to, or changes in, work that is covered by contract." Such "extra" work has long been a source of contention between contractors and buyers. Three of the principal reasons for this are:

1. Buyers cannot become reconciled to the seemingly high operating costs of electrical construction.
2. There is a great tendency to let the general contractor set the pattern for markups and billing.
3. Buyers are trying to keep costs within an appropriate amount.

Contractors and estimators undoubtedly are familiar with the foregoing causes. Now, let's concentrate on practical solutions that will minimize any contractor-buyer friction generated by these conditions.

## Suggested Practices

Wide variation in types of contracts, extent of extras, material-labor ratios, and many other factors, make it impossible to set up any fixed rules. However, we can establish certain practices that will tend to stabilize billing and, simultaneously, do much to educate the buying public.

The following practices can be used to secure justified markups and amicable settlements:

EST. NO. 1876  
DATE Jan 7 - 1957

PRICING SHEET

1876

JOB OR BLDG BROWN MEHL FABRICATION

BID TO ADDRESS

ARCHT. OR ENG'G ADDRESS

PLANS MARKED WIRE FOR 1 CONN 50 HP MOTOR M. SPEC. NO. EST. NO. 1876 SHEET NO. 6

EST. BY PRICED BY EXTENSIONS BY CHECKED BY S.D. NO. SHEET NO. 6

MATERIAL	QUANTITY	MATERIAL	EXTENSION	EXTENSION	
ADDITION - PLAN ET REL 4 REL	50	80.00	40.00	70.00	30.00
2" H.W. GAL CONDUIT	4	13.00	16.00	20.00	14.00
2" H.W. - 1/2" E.P.B.S.	200	600.00	120.00	200.00	50.00
NO 30 "RAN" WIRE	8	16.00	16.00	20.00	2.00
CONDUIT HANGER ROSEBUD	1	12.00	10.00	4.00	2.00
400A 240V 3P R SW	1	2.00	10.00	1.00	1.00
400A O.T. FUSE	3	7.00	2.00	5.00	1.00
3/4" MOTOR HEAD	2	18.00	3.00	5.00	1.00
2" FLEX CONDUIT	6	25.00	1.00	1.00	1.00
2" - " FLEX	17	15.00	1.00	1.00	1.00
2" INSUL ROPE	1		14.00	4.00	1.00
2" A-N			8.00	1.00	1.00
INST. STARTER & CONN BOX					
INCIDENTAL MAT. & LAB					
CHARGE					
TOOLS - 3% OF 210.00					
ESTIMATING & CHECKING					
INSURANCE - 1.00 (1.00) 1.00					
SALES TAX (ON 210.00)					
SERVICE OVERHEAD					
SERVICE RETURN					
3% PA. MAT.					
3% PA. LAB					
3% PA. - TAX JOB					

FIG. 1. ADDITIONAL WORK not affecting main contract can be estimated and billed in normal manner. Change orders are more involved.

When figuring and billing extra work—

1. Include direct job costs as such. Do not try to cover them by using a high overhead markup.

2. Vary overhead according to the volume of change.

3. Use separate markups for material and labor.

4. Use individual estimates for additions and omissions, when changes and substitutions are made.

5. Omit or reduce normal overhead when applying it to omissions.

6. Use representative overhead so that the markup for profit will not have to be boosted to help cover operating costs.

Three things always must be remembered: 1) It is easier to sell direct job costs than it is to sell overhead. 2) It is easier to sell overhead than it is to sell profit. 3) It is easier to sell labor markup than it is to sell material markup.

First, let's study the problems of dealing with private business. Work with government agencies will be a separate subject.

The foregoing recommendations can be best illustrated by the hypothetical estimates which follow. It is common practice for contractors to substantiate their charges by reviewing the estimate with the buyer. Many customers insist on having estimates to show how costs were arrived at. Our examples will be treated as though the practice of submitting estimates was general.

### Contract Additions

When only a contract addition (no changes or substitutions) is involved, the estimate can be prepared in the conventional manner as indicated in Fig. 1.

To avoid too many listings in Fig. 1, the cost of the foreman's and superintendent's time is included in the labor units. Job costs such as cartage, tools and insurances are listed. In most cases, there will be additional listings for items such as incidentals and inspection.

For markup purposes, job costs are treated as material items. There are two reasons for this: 1) They do not justify a higher markup. 2) To use the same markup as for labor would be inviting trouble.

The item labeled "Service and Overhead" is just plain overhead,

CH. EAST EST. 11502 PAGE 4		PRICING SHEET		DATE JAN. 5		1952	
JOB OR BLDG. BROWN MET. PRODUCE CO.		ADDRESS		ADDRESS		SHEET No. 2	
ARCHT. OR ENG.		ADDRESS		SPEC. No.		EST. No.	
PLANS MARKED OMIT 50HP PUMP MOTOR		EST. BY		PRICED BY		EXTENSIONS BY	
EST. BY		PRICED BY		EXTENSIONS BY		CHECKED BY	
S.D. No.		SHEET No. 2		S.D. No.		SHEET No. 2	
MATERIAL		QUANTITY		MATERIAL UNIT		EXTENSION	
LABOR UNIT		EXTENSION		LABOR UNIT		EXTENSION	
CREDIT - PLAN ET-REV. 141KSE							
2" H.W. CONDUIT		50		80%		40%	
2" ELS. & CABLE		4		80%		12%	
INST. STARTER & CONN. M.		1		80%		12%	
INCIDENTAL MAT. & LAB.		1		80%		12%	
TOTALS		350.53		240.00		240.00	
TAXES - 32.91 (20% (10% IN SUB. MARKUP - 12.36) + 10.55)		317.62		229.00		229.00	
SERVICE OVERHEAD (10% NORM.)		31.76		22.90		22.90	
SERVICE RETURN (10% NORM.)		31.76		22.90		22.90	
CREDIT - MAT.		31.76		22.90		22.90	
" LAB.		31.76		22.90		22.90	
TOTAL CREDIT		63.52		45.80		45.80	

FIG. 2. PRE-START CREDIT for omissions ordered before main contract work is started may justify some credit allowance for overhead and return included in original contract.

000 00000 000 00000  
 0000 0

PRICING SHEET

DATE APRIL 1 1952

JOB OR BLDG. BROWN METAL PRODUCE CO. LOCATION

BID TO

ADDRESS

ARCHT. OR ENGR.

ADDRESS

PLANS MARKED OMIT 50HP PUMP MOTOR SPEC. No. EST. No.

EST. BY PRICED BY EXTENSIONS BY CHECKED BY S.D. No. SHEET No. 3

MATERIAL

QUANTITY

MATERIAL UNIT

EXTENSION

LABOR UNIT

EXTENSION

CREDIT PLAN ET, REV 220KSE

2" H.W. CONDT

50

80%

40%

70%

35%

2" ELS. & CABLE

4

80%

12%

3%

18%

INST. STARTER & CONN. M.

1

-

40%

40%

40%

INCIDENTAL MAT. & LAB.

1

-

8"

40%

18%

TOTALS

350.53

240.00

INSURANCES - LAB

33.60

24.00

SERVICE RETURN (10% NORM.) 2%

33.60

24.00

9.60

TOT. MAT

316.93

216.00

TOT. LAB

240.00

TOTAL - TOP JOB

556.93

FIG. 3. POST-START CREDIT for omissions ordered after main contract work is started may not justify any credit allowance on overhead and return included in original contract.

but it reminds the owner that electrical contracting is a service trade. He is willing to pay more for services and overhead than for just plain overhead. The term often has its sales value.

A buyer might take exception to the 35% applied to labor. If so, he can be shown that 10% applied

to material and 35% applied to labor, produces a lower cost than 20% applied to the combined cost. This, of course, would not be true in the case of a low M/L (material-labor) ratio.

The markup for "Service Return" is extremely modest, but practice and competition have built



PRICING SHEET		DATE	JAN 10		1059
JOB OR BLDG	SHELBY PRODUCTS		LOCATION		
BID TO			ADDRESS		
ARCHT. OR ENG.			ADDRESS		
PLANS MARKED	PLANS E-213-12/22/58		SCALE	SPEC. NO.	EST. NO.
EST. BY	AJ	PRICE BY	EXTENSIONS BY	CHECKED BY	S.O. NO.
					SHEET NO. 7
MATERIAL			QUANTITY	MATERIAL	EXTENSION
LABOR					
EXTENSION					
CREDIT - ORIGINAL LAYOUT					
4" CONC. BOXES & PL.			28	50%	14.00
12" T.W. COND.			280	10%	28.00
NO. 12 T.W. WIRE			700	15%	105.00
T.W. BOX CONN.			56	20%	11.20
T.W. COND. CPLES.			30	15%	4.50
TOTALS					62.00
TOTALS & CARTAGE					5.00
INSURANCE - 15% (4.50)					9.00
SEV. F.O.H. (15% NORMAL)			2%		1.20
SERVICE RETURN (15% NORMAL)			2%		1.20
TOTAL MAT.			480		27.00
TOTAL CREDIT					255.10
ADDITION - REVISED LAYOUT					
4" CONC. BOXES & PL.			30	50%	15.00
12" T.W. COND.			300	10%	30.00
NO. 12 T.W. WIRE			750	15%	112.50
T.W. BOX CONN.			60	20%	12.00
T.W. COND. CPLES.			33	15%	4.95
TOTALS					73.45
TOTALS & CARTAGE					5.00
INSURANCE - 15% (4.50)					9.00
ESTABLISHMENT & CARRYING					10.00
SEV. F.O.H.			10%		10.00
SERVICE RETURN			5%		3.67
TOTAL MAT.					127.40
TOTAL ADD'L.					33.05
TOTAL CREDIT					208.45
NET AMOUNT					826.90

FIG. 4. TWO ESTIMATES, one for original and one for revised layout, are often necessary on changes to secure adequate reimbursement for estimating and plan revision costs. Note reduced markup on credit estimate. Omitting all markups on credits is often justified.

barriers that are hard to overcome. If one can use 10% on material, he is not asking too much. Minimum markups on material, however, make it easier to collect justified markups on labor.

#### Pre-Start Credits

Fig. 2 shows an estimate for work to be omitted from the original contract. This request came before the main contract work started. The estimate assumes that the contractor included normal markups in his original price. Of course, markups for credits must be less than those used for the original contract.

Immediately, some readers will ask, "Why figure any overhead and return (profit) in a credit estimate?"

For two reasons:

1. We cannot close our eyes to facts.
2. The estimate for a credit before the job starts sets a pattern for billing extra work to follow.

**Facing The Facts.** The "omission" estimate in Fig. 2 was prepared before any work was started. The contractor's only expense was that of including the work in the original estimate and figuring the credit. This is only a small part of the cost for supplying the complete installation and the owner knows it.

A contractor can justify his claims for part of the overhead and profits, but not all of it. Fig. 1 shows the original estimate to be \$826.90. Fig. 2 shows a credit of \$699.70. The difference is \$127.20. For this type of work, it is just.

For the same volume change in branch wiring it would more than likely be inadequate.

**Setting Future Billing Pattern.** The estimates submitted at the beginning of the contract set the pattern for future billing. The buyer endorses the 40% of normal overhead as being acceptable for credits and at the same time he endorses the normal overhead as being suitable for additions. When he studies the credit he learns what to expect in future billing.

#### Post-Start Credits

Fig. 3 is an estimate for a credit after the main project is under way. It is for normal conditions. Other conditions will be discussed later.

Cartage and tools are not included in this estimate. The tools and material have been delivered and tools are subject to much the same depreciation as if used.

There is no credit for overhead because the contractor's operating costs are as great, or perhaps even greater than they would have been had the work gone ahead as contracted for. The work has been figured twice. A special trip may be required to explain the credit. A letter must be written. Plans must be changed. The credit will have a separate entry on the books. For all of this, the contractor is asking \$185.45—the difference between the totals in Figs. 1 and 3.

The estimate in Fig. 3 is for normal conditions. However, the materials may be such that they cannot be used on any other part of the job. By the time they are returned they may not be in good enough condition to be used on another project. Under such conditions no credit could be allowed for material and the labor credit would have to be reduced to take care of the extra handling expense. There are many other factors that could justify reducing credit allowances.

#### Change Orders

Change orders are a special type of extra. In many cases, they amount to cancelling a portion of the original contract and substituting a brand new installation. Cost of figuring them is all out of proportion to the actual change in the cost of material and labor. To avoid excess losses, two estimates must be made.



Fig. 4 shows the credit and addition estimates for a completely revised lighting layout (hypothetical). The actual change involved only the quantities for two outlets. However, the materials for both layouts had to be measured off and listed. A difference of \$83.75 (addition) between the two estimates is shown. This would be more than a normal charge for two outlets, but it is a small charge for the contractor's services.

Had an estimate been prepared for just the difference in materials it would have been as illustrated in Fig. 5. The \$21.30 result would little more than pay for the estimating time.

If an owner insists on having an estimate for just the change in quantities, the contractor must include ample allowance for estimating time, and use markups in keeping with the volume of change.

It cannot be stated too often that the contractor always must use discretion. There are times when he will find it prudent to make no charges at all for the types of changes we have been studying. The markup on the main contract may justify such action, or he may be able to make up the loss on some other extra. Some owners do not object to paying a reasonable price for major additions or changes, but it annoys them to be billed for small items.

In suggesting a sliding scale for billing additions and changes, it is not expected that any such prac-

tice can be generally established. However, something must be done to convince buyers that the cost of supplying such work runs high. Here, varied markup can be used to advantage.

There are curves, based on substantial research (see Electrical Estimating, McGraw-Hill Book Co.), that show how overhead costs vary according to the volume of contract. The variation in the cost of extra work is much the same. Contractors have used these curves to boost allowed markups.

When a buyer sees curves that show how overhead drops from 30% for a \$500 job to 9% for a \$100,000 job, he realizes that small additions must have higher markups than the main contract.

An established practice is to use the same markup for all extra work throughout the life of a contract. No doubt contractors will wish to continue this practice if allowed a substantial amount. If the buyer objects to the billing, the contractor can offer him the option of accepting a fixed amount or a sliding scale for markups. Chances are that, in the end, a fixed amount can be established. It will simplify billing for the contractor and checking for the buyer.

A sliding scale of markups offers the more reasonable form of billing. It protects the owner against high charges on large volumes and protects the contractor against losses on small volumes.

Contracts for government work,

obtained from architects or private engineers, are sometimes prosecuted in a manner similar to that used for private work. They prove inviting. Contracts obtained in other ways prove difficult.

Whether contracts are obtained through prime contractor or directly from government representatives, the markups allowed are patterned after those designed for the general construction. With such restrictions, it is difficult for the electrical contractor to make expenses on small change orders.

The author is familiar with work partially subsidized by the government. The contractor is allowed to add 15% to his cost. This is supposed to cover all of the contractor's overhead and allow a profit. For small electrical additions and changes, the amount is ridiculous.

Again the importance of direct job costs and separate estimates must be stressed. Tools, cartage, insurances, engineering, and blue-printing are all legitimate charges to the job.

In cases brought to the author's attention the contractor has found government agents ready to cooperate with him in getting the best settlement possible under the conditions of the contract.

### Extras No Bargain

The ordinary extra is no bargain. A contractor may think he is making money on additions and changes. If he realized how they were affecting the main contract, the results would not look so gratifying.

Many contractors have long contended that the best results are obtained on jobs where few or no changes are made. Extras often retard the main contract and are responsible for excess labor.

If there are changes in one trade, more than likely there will be changes in other trades. With too many changes comes confusion. The project drags. The better mechanics are tied up longer than anticipated. Profits dwindle.

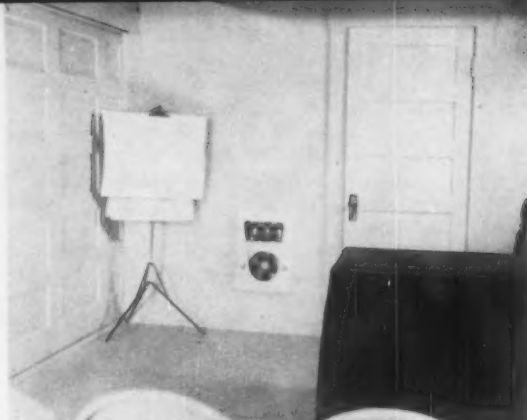
Any electrical contractor will do well to cultivate offices that turn out complete and comprehensive plans of the type that require no change orders. With such plans, the work of all trades moves with dispatch and the electrical contract rides along, with those of other trades, to an early and satisfactory completion.

FIG. 5. SIMPLE WORK ADDITION does not involve same estimating and plan checking expense as a revised layout requiring same amount of material. Compare Fig. 4 and Fig. 5.

CH. 1-1015 1-27 10000. FORM 4				PRICING SHEET		DATE JAN 18		1957					
JOB OR BLDG. SHELBY PRODUCTS		LOCATION											
BID TO		ADDRESS											
ARCHT OR ENG		ADDRESS											
PLANS MARKED PLANS E 283 - 12/2/56		SPEC. NO.		EST. NO.									
EST. BY		PRICED BY		EXTENSIONS BY		CHECKED BY		S.O. NO.		SHEET NO. 5			
		MATERIAL		QUANTITY		MATERIAL UNIT		EXTENSION		LABOR UNIT		EXTENSION	
ADDITION													
		4" CONC. BOXES & PL		2		50%		100		200		400	
		1/2" F.W. CONDT.		10		10%		200		200%		400	
		NO 12 TW. WIRE		50		15%		75		30%		150	
		T.W. BOX CONN.		2		20%		80				160	
		T.W. CONDT. C.P.L.G.S.		2		15%		30				150	
								485				950	
		INSURANCES 15% of 9.50 (14)						130					
								620				950	
		SERVICE & Q.H.				10%		60		35%		300	
								680				1280	
		SERVICE RETURN		5%				35		10%		130	
								715				1415	
		TOTAL MAT.						715					
		TOTAL LAB.								1415			
		TOTAL - INC 10%						786.50					



**21 KW OF RADIANT BASEBOARD HEATING** was installed in this 100-year old, ten-room home. Powering the heating system is a new 200-amp, 3-wire service entrance. Existing walls of the home are constructed of 6 ins. of solid wood and were not insulated further. The only insulation installed as part of the overall heating job was 6 ins. of wood fiber blown into the attic, plus 2-in. aluminum-covered batts tacked to the bottom of the first floor joists. The home, which is located only one block from the city's business district, marked Hartford City Hardware and Electric Company's entry into the electric home heating business. Since this time they have made over 100 individual installations with a total connected load of 1625 kw, half of which have been made in existing homes, replacing heating plants ranging from pot bellied stoves to comparatively new central fuel-fired systems. Included is one heat pump installation in a home only two years old.



**SUNDAY SCHOOL CLASSROOM**, one of three added to Hartford City's Christian Church, is heated by wall-mounted, fan-driven, 3000-watt electric heaters. The heaters, besides being less expensive to install than fuel-fired units, eliminate unsightly pipes, expensive ductwork, fuel tanks, smoke, fumes, noises and drafts. Also, the clean electric heat minimizes caretaking time. Units are energized only when needed (a few hours each week), and only a short warm-up period is necessary to provide genuine comfort throughout all parts of the room. The Woolard Electric & Electronic Company of Hartford accomplished the installation.

## Electric Heat Clicks

An eastern Indiana community provides a powerful example for electrical contractors everywhere of the business opportunities in electric heat application.

By W. J. Martens

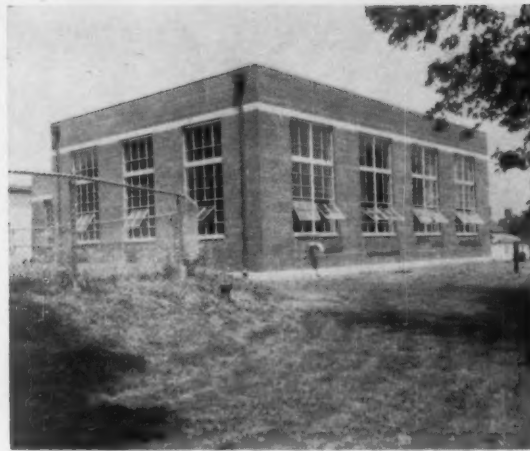
Is electric heat only for big city folks? Hartford City electrical contractors know better. From a standing start five years ago this eastern Indiana community boasts electric heat installations already running three times the national average and still headed upward. The utility, Indiana & Michigan Electric Co., started promoting electric heat in the area in 1954. The local electrical contractors were quick to take advantage of the opportunity. A combination of sound selling and top quality installation practice created a solid base for the strong growth of electric heat application in this community. It could happen in your town!

**A**REAS such as Hartford City are close to the farm, and electricity isn't taken for granted. Since the beginning of rural electrification, the use of electricity on the farm has increased rapidly. To the farmer it is accepted as one of the safest and most economical means of heating and pumping water, cooling large quantities of milk, accomplishing cooking and laundry tasks, driving machinery, heating animal out-buildings and milking parlors, lighting barns and sheds, and illuminating barn yards, as well as the main house.

How do these factors affect the rapid growth of electric heat in Hartford City? It is simply this—since the use of electricity has become the accepted way of accomplishing farm tasks, the farmer is a most promising prospect for electric home heating. Many farm houses are in need of modern up-to-date heating systems, and once the

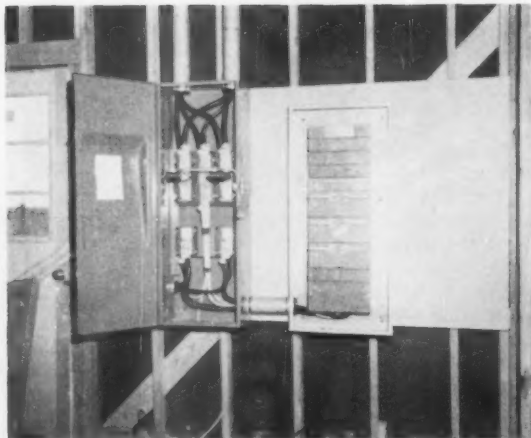


**INDUSTRIAL BLOWER-TYPE AIR HEATERS** provide 105 kw of electric heating in this municipal water works pumping station. A total of seven 15-kw, fan-driven, wall-mounted blowers deliver fast dependable automatic heat to a pump room, office and chlorination room. Each of the rooms is individually controlled from surface-mounted line-voltage thermostats. Since the heating system requires no maintenance, employees manning the station are left entirely free

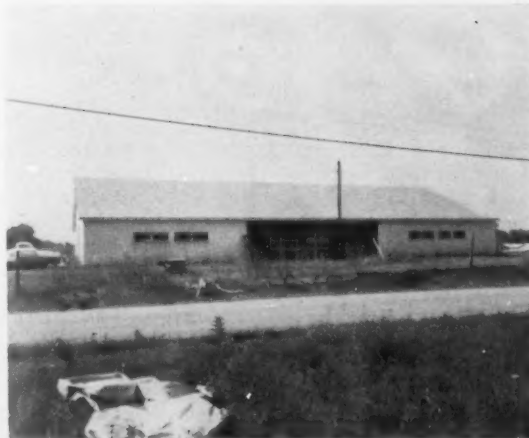


to perform their regular duties without bothering about maintenance procedures normally required for fuel-burning heating systems. The only adjustments necessary are to turn the various thermostats to desired settings. Power supplying the heating system and an array of pump motors is fed by a 600-amp, 440-volt, 3-phase, 3-wire service entrance. Contractor was Morehead Electric Co. of Marion, Ind.

## in Hartford City



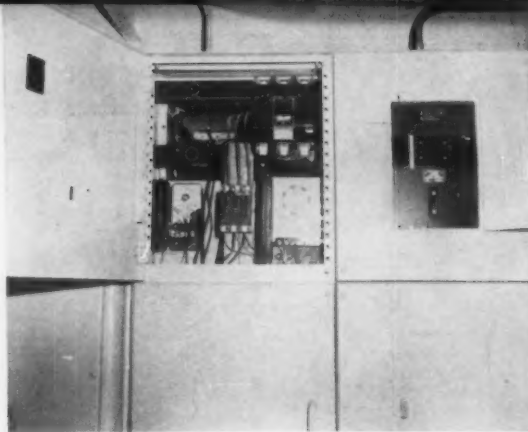
**4-H COMMUNITY BUILDING** (70-ft by 180-ft) currently under construction on the outskirts of Hartford will feature 3 types of electric heat: heating cables in the concrete floor, wall heaters and ceiling heaters. The perimeter of the building is insulated with 2- by 24-in. sheets of styrofoam. The underfloor area is covered with a plastic film vapor barrier, plus 4 ins. of insulating concrete. Side walls have 4 ins. of wood fiber insulation, while attic space has 6 ins. of blown-in



wood fiber. A 600-amp, 120/240-volt, 1-phase, 3-wire main service feeds all the building's heating, cooking (electric) and lighting loads. The barn-type building is being constructed to be used as a community meeting and activity center. A plus feature of the heating system is that it will be divided into 6 zones, each thermostatically controlled. The under-floor cable is designed to keep the temperature of building at approximately 50 degrees.



**FIRST ELECTRICALLY HEATED SCHOOL BUILDING** in the Midwest was Hartford's Parkside Elementary School. (See page 80, *Electrical Construction and Maintenance*, Feb., 1957.) In the kindergarten room (above), electric heater-ventilator units installed under windows are supplemented by electric heating cables. The underfloor cables, governed by a separate thermostat, warm a section of the room's floor used as



a rest area. Heating load for the school total 276 kw. Cooking and water heating loads total 76.8 kw. The heater-ventilator units' fresh air intakes are automatically controlled by a time clock installed in the main switchgear housing (above). The time clock also controls night setback. The utility provides a special rate recently reduced to 1.6 cents per kwhr for electrically heated public schools.



**ELECTRIC HEAT IN NEW RESIDENCE.** This is one of the many types of electric heating systems being installed throughout the Hartford City area. Residential electric heat, aside from reflecting a substantial increase in revenue for electrical contractors, is also responsible for increased appli-



cance sales in the All-Electric home. For example, the owner of this home, besides having a complete ceiling heating system, will use electricity for cooking and laundry tasks, and water heating. Provisions also have been made to cool the home. The radiant cable heating load totals 14.4 kw.

farmer installs electric heating in his house and enjoys its benefits, he is quick to point out all the advantages of the heating system to his neighbors and his friends in town.

The Indiana & Michigan Electric Co. started promoting electric heat over five years ago—a time when many utilities throughout the country openly discouraged its use. One of the company's first promotional steps was to arrange meetings with local builders, electrical contractors, lumbermen, heating dealers and financial representatives. At this time they presented their case for electric heat, calling particular attention to revised rate schedules which would make its costs more

attractive. Then they instructed contractors on estimating and installation procedures. They also offered free engineering services on heating layouts. They advised contractors of prospects and encouraged them to sell one job to gain installation and operation experience. They created interest and instructed the public on the benefits of electric heat. And they kept in close personal contact with contractors, cooperated in manning displays in their stores during special promotions, and encouraged the placement of displays at various public affairs. Finally, a budget billing program was set up to enable customers to spread their heating costs over a 10-month period.

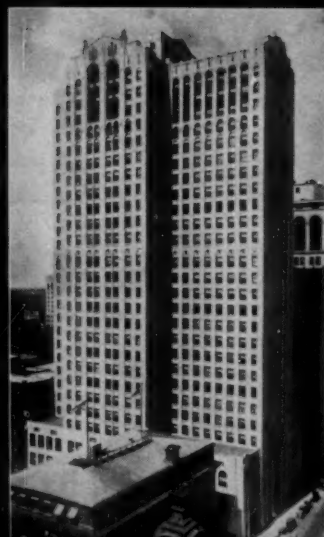
Electrical contractors interested in capitalizing on this opportunity for more business fulfilled their part in the success story by making sure they provided each buyer with the best installation possible.

The utility's Hartford City branch covers an area of 900 square miles—serving a total of 11,300 customers. Electrically heated homes on its lines include over 300 resistance-type jobs, plus four heat pump installations. Of the total number of installations mentioned above, 37% are conversions and 63% are in new homes. There are also a number of commercial applications, including two school buildings completely heated electrically.



Contractor  
planning  
minimizes  
electrical  
modernization  
costs

YOU CAN BE SURE... IF IT'S **Westinghouse**





**COVER PHOTO:** William F. Lorenz, W. D. Gale, Inc., Electrical Contractors; and H. C. McDaniel, Branch Manager, WESCO, Detroit, examine new Westinghouse building-type switchboard which is used to protect and distribute power to upper floors of Buhl Building. Size and weight of equipment placed in this room had primary importance. Installation was made without enlarging doorway shown. **COVER INSET:** Buhl Building, Detroit, Mich., built in 1925, has long been one of the city's preferred business locations. Electrical modernization, completed in 1958, assures the building's continued "Class A" rating with adequate electrical facilities for many years to come.

M. E. Tisdale, Westinghouse Sales Engineer; Ralph E. Thomas; and William F. Lorenz check two banks of single-phase, 4800-volt Westinghouse dry-type transformers for operating audibility. (Three 100-kva units, and three 167-kva units with top connections housing the low-voltage leads.)



Close-up of building-type switchboard shows AB De-ion® type molded case feeder breakers. In background, Ralph E. Thomas; James E. Miller, Westinghouse Construction Sales Engineer; and William F. Lorenz are shown with three 100-kva DS-3 dry-type transformers. Westinghouse dry-type transformers were specified because of their smaller size and lighter weight. (Structural load had to be considered, as this converted rooftop room was not originally designed for equipment.)



William F. Lorenz, M. E. Tisdale and Ralph E. Thomas (who, in addition to being Building Manager, is a registered professional electrical engineer), discuss the electrical plans which resulted in maximum modernization of Buhl Building at minimum cost and inconvenience.

## Buhl Building modernizes to Build Business Electrically for next 20 years' growth

Plans for the electrical modernization of the Buhl Building in Detroit began with an analysis of the present electrical needs of the building and its tenants and a careful estimate of its possible requirements for the next 20 years.

The Building Manager, Ralph E. Thomas, worked closely with William F. Lorenz, Engineering Representative of the Electrical Contractor, W. D. Gale, Inc., Detroit, in pre-planning the electrical system. It was decided to double the capacity by retaining the existing system to supply power to the lower half of the building. A new source for power distribution would then be installed on the roof of the building to supply the upper floors.

Westinghouse electrical equipment was specified for the installation, since special considerations of size, weight and quietness had to be satisfied. Included in this equipment was a Westing-

house building-type switchboard and Westinghouse DS-3 dry-type transformers. These were moved to the roof by the building's regular service elevator and installed in an existing room there. It was not necessary to enlarge any doorways or break through any walls. The minimum weight of the Westinghouse equipment permitted installation without structural reinforcement. In addition, the dry-type transformers were proved to be completely noiseless and vibrationless.

Important to both the contractor and the building management were the savings realized by this ease of installation. Final costs proved

*(continued)*

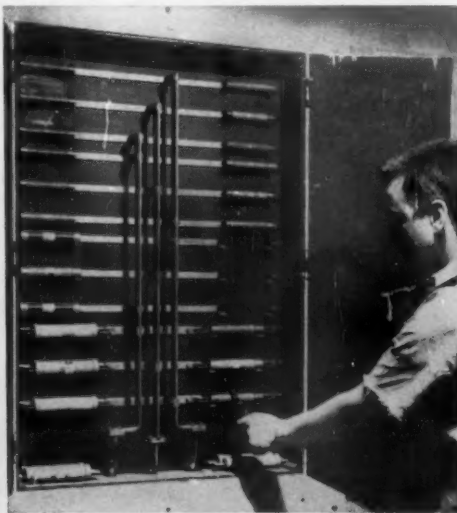
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**Westinghouse**

**S** Over 250 Pages Westinghouse Data in Sweet's Construction File.

J-94131-3



The primary oil circuit breaker arrangement shown will insure a power supply to building tenants under any fault conditions. M. E. Tisdale, William F. Lorenz and James E. Miller are in front of oil circuit breaker relay panel.



New Westinghouse Type FDP, completely safety protected combination switch and fuse panelboard, at right, has replaced the older, unsafe, live-front panelboard shown at left. This new panel not only safely protects all fuses and bussing, but the quick-make and quick-break switches provide positive opening and closing of the circuits.





William F. Lorenz points out to Ralph E. Thomas and H. C. McDaniel the key interlock in handle of one of three Type LCB air disconnect switches. With these switches, transfer can be made from primary lines to insure constant power supply to lighting and power transformers in new electrical equipment room. The Westinghouse DS-3 single-phase dry-type transformers shown in rear each feed a section of the building-type switchboard.

The new pump and Westinghouse 50-hp Life-Line® motor keep the water reservoirs automatically filled on the various floors of the building. This new single pumping unit can perform more efficiently than the two pumps and 50-hp motors previously used.

William F. Lorenz of W. D. Gale, Inc., Electrical Contractors, holds degrees in both Civil and Electrical Engineering. His knowledge of currently available electrical equipment, and engineered preplanning, together with the skill of his firm's personnel in actual installation procedures were major factors in the economical and efficient electrical modernization of Buhl Building.

## Buhl Building modernizes to Build Business Electrically for next 20 years' growth *(continued)*

less than those estimated by both the contractor and management.

Westinghouse can help you in solving your modernization or new construction problems . . . to Build Business Electrically.

See the Westinghouse distribution outlet nearest you or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.

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J-94131-4





# Practical Methods

## Electric Heat for Portable Schools

### HEATING

Suburban school districts surrounding Seattle, Wash., have found a solution to overcome the school-room shortage, a problem faced by most communities. The solution is the use of one-room portable schools that can be jacked up and put on flatbed trucks when moving is necessitated.

These frame buildings are used where new construction or overflow conditions cause congestion. Cheaper and faster to construct than permanent buildings, their construction permits ready installation or removal from a site, yet

features the appearance of permanent structures.

One of the major considerations for the portable buildings was the selection of the heating method. Simplicity of installation and disconnection were important factors in the ultimate choice of the heating system. Westinghouse baseboard electric heating was eventually selected, permitting a single utility service for both heating and lighting.

Further investigation showed that electric heating was no more expensive than other types, and it represented a definite saving in labor. Well suited to portable classrooms, the system eliminates the presence of fuel lines, chimneys or pipes, and provides more available

space and neater appearance.

Each portable classroom—30 by 30 ft, with one wall of glass—is comfortably heated with 13 kw of baseboard electric heating. Featuring rapid and safe operation of the units, the teacher has complete control of the classroom temperature through the use of a wall-mounted thermostat.

Time clocks control the thermostats, and in the morning, only a few minutes are needed to warm the classrooms. Economy is effected since the buildings are heated only when in use, and the electric heating causes no change in the air except to warm it to a comfortable temperature and circulate it simultaneously.

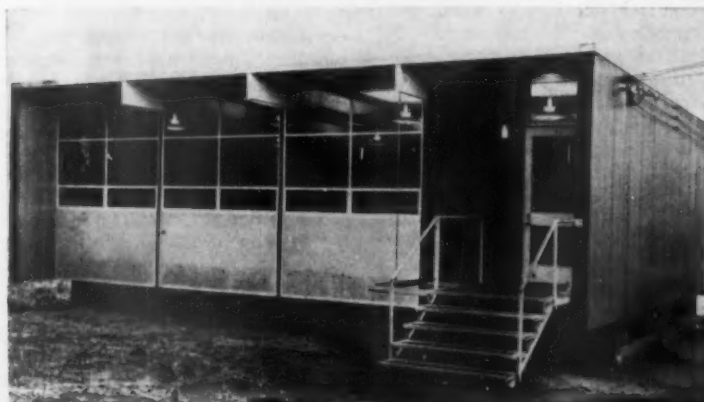
Heating sections are 2 ft long, and 7 ins. high, and fit together to form a continuous unit, replacing ordinary baseboard. Rated at 500 watts per section, the heating system is appropriate for school buildings since no drafts are created. Incandescent room lighting adds heat to the room, and with thermostatic control, less heating is required.

Ewing Electric of Edmonds, Wash., installed the electric heating in the portable classrooms in Redmond grade and junior high schools in the Lake Washington School District, and Chapman Electric of Renton, Wash., installed the heating units in the other portables.

Permanent school buildings in the Seattle area are also finding electric heating efficient and economical. Consulting Engineer B. A. Travis, who designed the electrical system in the Burien Heights elementary school, found that he could use electric heating at an installed cost of less than 85¢ per sq ft, compared with \$2.50 to \$3.00 per sq ft for a combustion system.



**EACH PORTABLE CLASSROOM** is comfortably heated with 13 kw of baseboard electric heating. Fuel lines and chimneys are eliminated, resulting in less waste space and no air drafts. Units are controlled by thermostat.



**SINGLE ELECTRICAL SERVICE** supplies lighting and heating systems to attractive, low-cost portable schoolrooms built to overcome classroom shortages. Facility of installation and removal of these buildings provides quick classroom additions wherever needed.

## Church Conditions With Heat Pumps

### HEAT PUMPS

The Congregational Christian Church of Fairfax County, Va., is a forerunner of at least seven other churches in the Virginia Electric and Power Company's territory to be air conditioned at the time of construction by the heat pump method.

The church heating system, originally laid out for steam boilers with space for water-chilling machines,

# Sylvania COP<sup>\*</sup> starters

with long-life Ceramic Condensers



**Robot COP<sup>\*</sup> Automatic Reset.** Built-in, thermal-operated device cuts flashing or non-operating lamp out of circuit. When defective lamp is replaced, starter automatically resets to operate new lamp. Designed for hard-to-start conditions—such as high humidity, ungrounded fixtures, low line voltage.



**COP<sup>\*</sup> Manual Reset.** Circuit-breaker element cuts flashing or non-operating lamp out of circuit until new lamp is installed. Push button at top of starter permits manual resetting of circuit-breaker for proper lamp operation when relamping.

## cut maintenance costs... protect against expensive ballast burnouts!

Sylvania COP (\*Cut-Out Premium) starters offer money-saving advantages. The circuit-breaker device AUTOMATICALLY cuts out failing lamps—starter life is not "used up" trying to start defective lamps.

This automatic starter feature saves time and work... eliminates annoyance of flashing lamps, postpones the need for lamp replacement, thus permitting group lamp replacement at less cost.

Sylvania COP starters protect equipment against ballast burnout from excessive heat produced by flashing lamps.

You get longer service with COP starters because, like all Sylvania starters, they have ceramic condensers. Condensers don't break down due to temperature or moisture—the cause of failure in starters with paper condensers. Order a stock of COP starters today from your Sylvania Representative or Supplier.

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**SYLVANIA**   
Subsidiary of  
GENERAL TELEPHONE & ELECTRONICS



**COMPRESSORS** of two-unit heat pumps installed in the Congregational Christian Church of Fairfax County, Va., were installed in courtyard, partially protected by roof overhang.

provides an interesting cost comparison between heat pump and conventional year-round air conditioning systems.

The 10 five-ton Carrier heat pumps were installed for \$28,600. Architect's estimates for conventional heating and air conditioning were \$45,000.

Also, by using two-piece units with the compressors located outdoors, the church gained 415 sq ft of usable area which would have been occupied by the steam boiler, water chillers, and space in front of the boiler to remove tubes for cleaning.

Even with construction costs running at a low \$13.50 per sq ft, this meant \$5,600 worth of building space could be used for classrooms which would otherwise shelter equipment. Furthermore, the packaged air conditioning units give good zone control, thus permitting economical heating or cooling of meeting rooms, kitchen or pastoral offices at times when the entire building is not in use.

Heat pump operating costs are estimated at \$1,383 per heating season (at an average 2.3 cents per kilowatt hour, including demand charges). This is about \$200 more than the estimated cost of heating with inexpensive No. 4 oil. Vice Chairman Theodore Smith of the Building committee, a licensed mechanical engineer, states, "I figured that with heat pumps we might easily save this \$200 on the wages we pay for janitorial help. Hiring a man who would know his way around the valves and gauges of a steam boiler system would certainly cost more than hiring someone who needed only to know how

to set the thermostats of completely automatic heat pumps."

The equipment is ranged along the wall of an interior court of the church building. Nine of the ten indoor sections are stacked compactly in a central equipment room occupying 285 sq ft of floor space and only 24 ft of exterior wall. Man-hours for the 50-ton installation totaled 1,370.

## Straddle Buggy Adapted For Transformer Installation

### JOB METHOD

When Stetson Electric of Los Angeles installed transformers and primary switchgear on the roof of California's new Furniture Mart (see "Downfeed Distribution," EC&M, June, 1959), it was necessary to hoist considerable heavy equipment up the outside of the building, then transfer it laterally to ten channel-bridge mounting locations positioned between roof-piercing column tops.

To aid in this latter operation, one of Stetson's foremen, Jim Duff, thought up the idea of using a straddle buggy (common as a lumber-moving vehicle). Since the buggy has an open-bottom U-shaped frame, it could be wheeled easily over the slightly-raised channel bridges on which transformers and switchgear cubicles were to be mounted. And, equipped with a ratchet manual winch, sheaves and hoist cable, heavy components could be raised from the roof, transported to their intended positions, then lowered into place with minimum



Note how ordinary EMT split early in pressure test while induction welded CIRTUBE EMT (shown here unplated) held fast, surpassing UL requirements.



## BETTER WELDING

**on new CIRTUBE EMT means easier, split-free bending**

**T**HERE are many reasons why new CIRTUBE EMT will help you get faster, cleaner wiring jobs. Most of them are listed here.

One *big reason*, however, is *continuous induction welding*—by far the best technique available for making bead-free, split-free welds on high quality EMT.

It is virtually impossible to split an induction-welded EMT no matter how severe the bends. And the perfectly clean weld means uniform roundness—easier, neater bending without the slightest kink or flattening. Your men get it right the first time around.

Try induction-welded new CIRTUBE EMT soon as you can. Your wholesaler has it now—bundled with distinctive orange colored tape to identify the EMT manufactured to Circle's quality standards.



# CIRCLE

WIRE & CABLE  
a subsidiary of  
CERRO DE PASCO  
CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. SALES OFFICES & WAREHOUSES: in all principal cities  
RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES  
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT

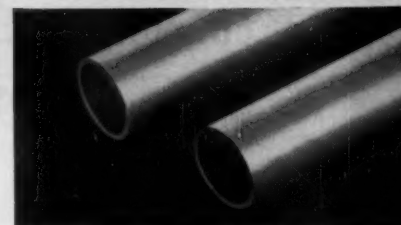
**CIRTUBE EMT**

*Ask for it!*



**Proper steel plus!** The best cold rolled steel plus the right handling give CIRTUBE EMT its natural bendability.

**Easy fishing!** A baked-on protective coating gives CIRTUBE EMT a built-in lubrication for easier wire pulling.



**Lifetime exterior finish!** Hard galvanized finish for durability; polished satin lustre for lasting good looks.

**Automated quality control!** Automatic controls assure complete and continuing uniform quality of product.

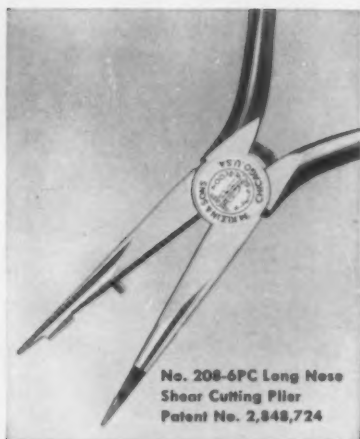


**Tight, easily handled bundles!** Bright, orange tapes hold CIRTUBE EMT securely for easy handling on and off the job.

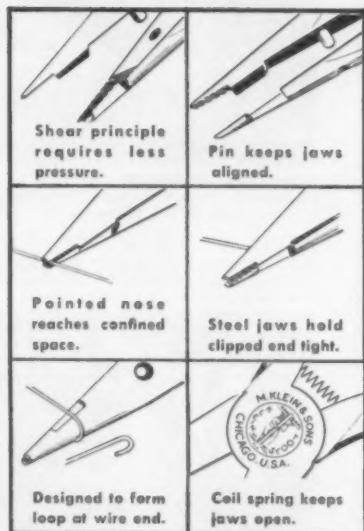
**Fast, friendly service!** Well-known Circle service through a nation-wide network of well stocked nearby warehouses.







## JUST THE PLIER FOR ELECTRONIC USE

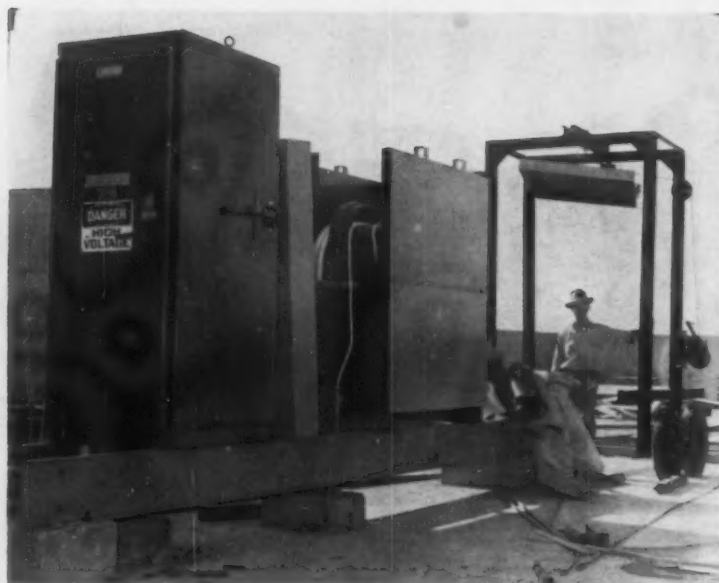


Here is a plier specially designed for electronic use. It will fit into confined space and steel jaws hold clipped end of sheared wire firmly... nothing to wear out.

The shear blade is at an angle of 15 degrees (the standard angle of regular diagonal pliers). Shear principle assures smooth, continuous action without snap, preventing shock which might damage transistors or delicate components. For use with bare wire up to 18 gauge.

See your electronic supply house or  
**WRITE FOR CATALOG 101-A**

Foreign Distributor: International  
Standard Electric Corp., New York.



**INVERTED U-SHAPED FRAME** of rubber-tired and winch-equipped straddle buggy can be moved over channel-bridge support for roof-based transformers and primary switchgear cabinets, permitting exact positioning of components with minimum shock and effort. Since ten such local outdoor transformer units were involved in the Furniture Mart installation, the buggy proved to be a definite labor-saving materials-handling tool. Jim Duff, job foreman for Stetson Electric, is seen standing at right.

effort and exact accuracy. Use of standard automobile wheels and balloon tires cushioned the buggy and permitted the movement of heavy components without the slightest jarring or impact.

As indicated, transformers are positioned directly above square ducts that descend through the roof to distribution panels located in corridor walls on the top floor of the Mart. Secondary cables therefore can be dropped vertically downward to this topmost panel, and, reconnecting to the bottom of the panel's bus structure, can then continue downwards in a successive cable-bus sequence until the lowermost panel in the tier has been reached.

## Magnetic Drill Holds Position

### TOOL

Cellular flooring, installed in Crown-Zellerbach's new 20-floor office building in San Francisco, is used to carry circuitry related to 120-volt floor-receptacles, communications and telephone service to all possible desk locations. And, since the structure contains approximately 7000 5½-by-5½-ft modular areas where such services could be desired, the problem of drilling the required number of duplicate

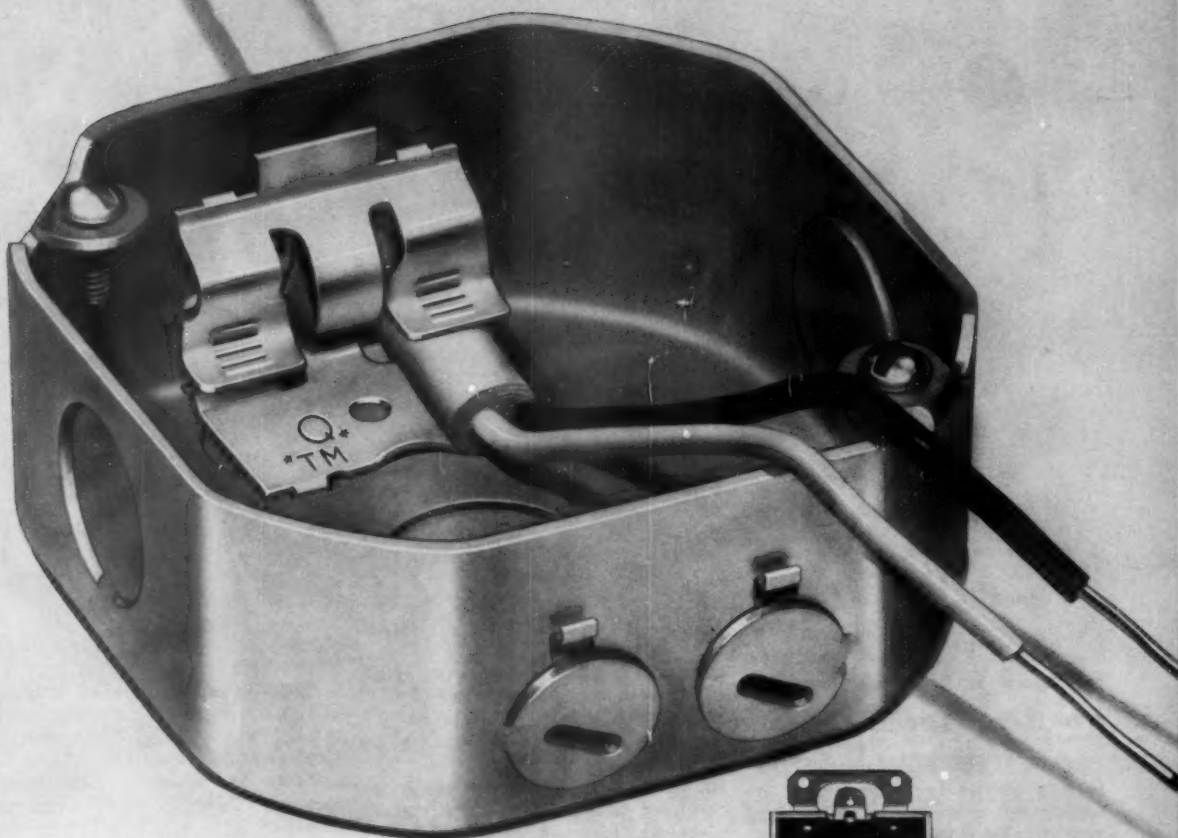
holes at these thousands of locations was an assignment of major proportions. It likewise was necessary to drill holes to correspond with all header duct connections, so it became expedient to select a method of drilling which would be accurate, fast and relatively easy.

The method selected by joint-venture contractors Charles A. Langlais and Ets-Hokin & Galvan



**DRILL PRESS** equipped with magnetic base having 1700-lb pull may be secured to metal base-plate fastened to work-bench, although intended objective in purchasing this rig was to facilitate drilling of countless holes in circuit-carrying cells of steel flooring. With drill held perpendicular at all times, drill-life is considerably prolonged.





## RACO screwless "Q" Quick-Clamp saves time on the job

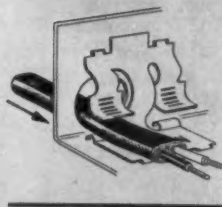
With RACO's new "Q" Quick-Clamp you can install non-metallic sheathed cable in seconds—without clamp screws. Simply push the cable through "Q" Quick-Clamp. Cable is held firmly in place, can't be pulled out until clamp is released. To release the cable, apply a little pressure under the clamp with your screwdriver. With the new "Q" Quick-Clamp there will be no more lost time tightening and loosening cable clamp screws... no more stripped screw heads.

And... you'll save an hour or more on the average job (60 to 100 boxes per house). Your RACO Distributor has the new "Q" Quick-Clamp Switch and Outlet Boxes. (Exceed Underwriter Laboratories' tests; are fully protected by patents.) See them and try them now.

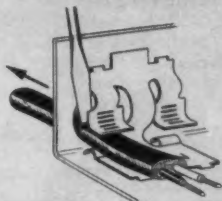
\*Trademark



"Q" Quick-Clamp available in RACO switch or outlet boxes



Cable moves freely into clamp and is gripped tightly



To back-off cable, release clamp pressure with screwdriver



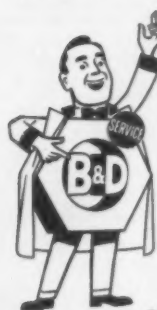
ALL-STEEL EQUIPMENT INC. Aurora, Illinois



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**NEARBY  
 SERVICE**  
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Black & Decker maintains 50 factory service branches plus authorized repair stations to give your B&D tools the attention every mechanical product needs periodically. Keep your B&D tools in top condition, on the job all the time.

Only factory parts and factory-approved methods are used. Fast service and reasonable cost, always.



SWIFTY SERVICE says  
 be sure to ask about:

**FREE TOOL INSPECTION**  
 no cost,  
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**STANDARD B&D  
 GUARANTEE** after  
 completion of all  
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 repair work.

You'll find the location of the nearest B&D repair facility in the Yellow Pages under "Tools-Electric," or write for address to: THE BLACK & DECKER MFG. Co., Dept. S3110, Towson 4, Md.



**Black & Decker**

Quality Electric Tools

was to use a magnetic drill. Mounted on an electro-magnetic circular base having a 1700-lb pull, the drill maintained far better positioning than could be obtained manually. Moreover, since the flat base kept drills exactly perpendicular to working surfaces at all times, wear on drill blades was constantly uniform and drill-life was prolonged enormously—in some instances by 400% when compared to hand-held drilling practices.

With separate switches controlling magnetic power and drill power it was possible to (1) carefully position the drill over any desired point, then (2) flip the related toggle switch to energize the magnet and thereby firmly anchor the drill assembly, then (3) squeeze the drill-handle trigger switch and lower the drill by using the ratchet wheel and hand pressure in combination.

Since the 1700-lb pull of the magnet is far greater than the weight of the drill unit itself, it is also feasible to use this drilling rig on vertical (or even upon overhead) metal surfaces. And, when the drill is not being used "on location" for cellular-floor drilling of holes, it may be placed on a workbench and used as an ordinary drill-press. As shown here, the workbench has been equipped with a flat square metal plate which, when secured to the bench top, serves as a level base and anchoring medium when the magnetic switch of the drill assembly is flipped on.

## Supporting Vertical Runs of IA Cables

### INSTALLATION

A vertical run of interlocked armored cables for 500 ft presented the problem of support for the cables. A non-rigid suspension of the cables was desired, which eliminated the obvious method of anchoring them to an adjacent wall. Suspension of crossarms on two steel ropes and the attachment of the cables to the crossarms with fittings specially designed for interlocked armored cable was the method chosen to meet the requirement.

The interlocked armored cables run to the ground surface switchyard from a power station built 500 ft underground by Pacific Gas & Electric Company near Fresno, Calif. The ends of the steel ropes were attached only at the top of the shaft and the metal crossarms were located every 12 ft along the wire,



**CABLE CLAMPS** supporting interlocked armored cable runs are mounted on special channel-iron crossarms.

thus providing the non-rigid suspension desired.

Interlocked armored cable fittings were used to fasten the cables to the crossarm supports. The fittings consist of basic connector and accessories: grounding fitting, support clamps and mounting bracket. Different combinations of the units meet all the terminating, dead-ending and supporting requirements of interlocked armored cable.

Each clamp, or saddle, used in combination with a mounting bracket was capable of supporting 850 lbs of cable weight. Convolutions on the inside of the clamp matched those of the armored sheath to give strain relief to the conductors without distorting the armor.

Another requirement was that the terminating connectors or fittings be insulated. Grounding current was high in the armored sheath, and Pacific Gas & Electric wanted only one end of each cable grounded. Combination of the connector and mounting bracket is used with no need for knockout flanges to terminate cable armor outside an enclosure.



**NON-RIGID SUSPENSION** is used for 500-ft interlocked armored cable run down to an underground power station from a ground level switchyard. Cables are clamped to rigid crossarms which are attached to steel rope in shaft.

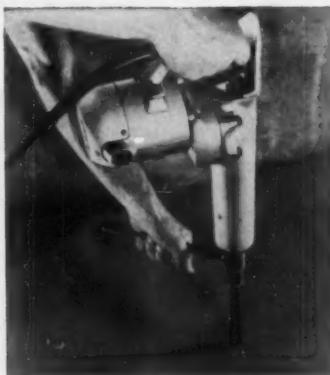
25 feet of conduit channel  
in just 1 hour!



## Look what Black & Decker's 1 1/8" Hammer can do for you!



BREAKING holes through concrete or brick; demolition work goes easier with bull point tool.



INSTALLING electric outlets in concrete is a cinch with a B&D Hammer.

TRIMMING excess metal or scaling after the job's done goes fast and easy with cold chisel.

MOUNTING electric signs, switchgear, etc. is fast work with powerful Hammer and star drill.



2,200 cutting blows a minute  
speed up electrical jobs

Here's the tool that helps you slash preparation time laying conduit in concrete floors and in scores of other jobs! Rugged Black & Decker Electric Hammers are power-packed to deliver thousands of hard, rapid, cutting blows to send your man-hours tumbling; output per worker climbing.

See for yourself what the B&D 1 1/8" Hammer can do for you in drilling, digging, piercing, breaking, chiselling and dozens of other operations. Mail coupon for free demonstration or additional information. **THE BLACK & DECKER MFG. Co., Dept. 1210, Towson 4, Md.** (In Canada: P.O. Box 278, Brockville, Ontario.)



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**Black & Decker®**

Quality Electric Tools . . . Power-built for top performance

MAIL TODAY FOR FREE DEMONSTRATION

THE BLACK & DECKER MFG. CO., Dept. 1210, Towson 4, Md.

- ☐ Please arrange a free demonstration of your 1 1/8" Hammer  
☐ Please send additional literature

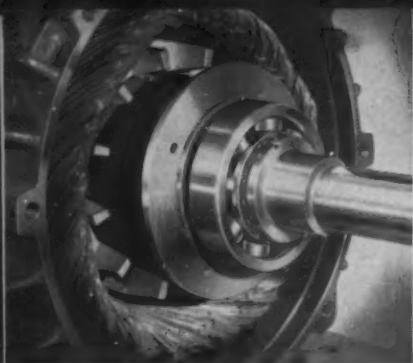
Name \_\_\_\_\_ Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_





**HEAVY DUTY BALL BEARINGS...** The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long trouble-free service under heavy loads.



**BEARINGS CAN BE RELUBRICATED...** Original factory lubrication will last for years in normal service—but convenient grease plugs are provided to permit relubrication that adds to motor life under severe conditions.



**SECURELY SEALED FOR LOW MAINTENANCE...** Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.

## **Wagner Totally Enclosed Motors** *Designed to give you Extra Protection*

**PROTECTED  
AGAINST  
CORROSIVE...  
ABRASIVE**

**AND  
EXPLOSIVE  
ELEMENTS**

Here are motors that will deliver full-rated horsepower under the toughest service conditions—that will help you keep your production rates up, and give you the kind of dependable, continuous operation that is so important to automation.

Type EP Motors are fully protected against damage from corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well—is designed and approved for use in explosive atmospheres.

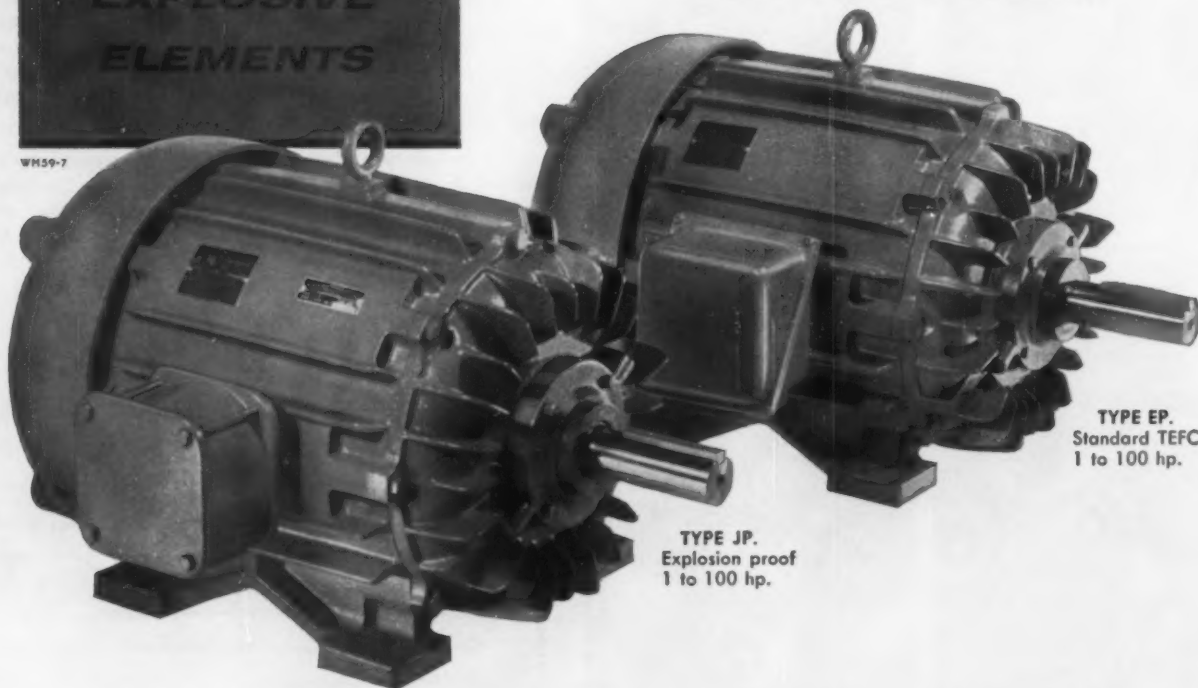
Integral ratings, 1 through 100 horsepower, are built in the latest NEMA frames, 182 through 445 US, with ribs that add mechanical strength and increase the surface cooling area.

Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs, and in continuity of operation.

Branches and Distributors in All Principal Cities

**Wagner Electric Corporation**

6413 Plymouth Ave. • St. Louis 14, Missouri



**TYPE EP.**  
Standard TEFC  
1 to 100 hp.

**TYPE JP.**  
Explosion proof  
1 to 100 hp.

OTHER FRAME SIZES AVAILABLE IN RATINGS THROUGH 500 HP.



# Motor Shops

## Variable-Width Yoke On Arbor Press

A prime requisite of an effective arbor press is to incorporate a "collar" or "yoke" that (1) has sufficient clearance to permit the unobstructed passage of a shaft, yet (2) has a snug enough fit around the shaft to provide a sturdy bearing surface. This double requirement sometimes means that an arbor press that is correctly dimensioned to efficiently facilitate the removal of a shaft from a specifically-sized motor is not necessarily correctly scaled for similar work on smaller or larger motors.

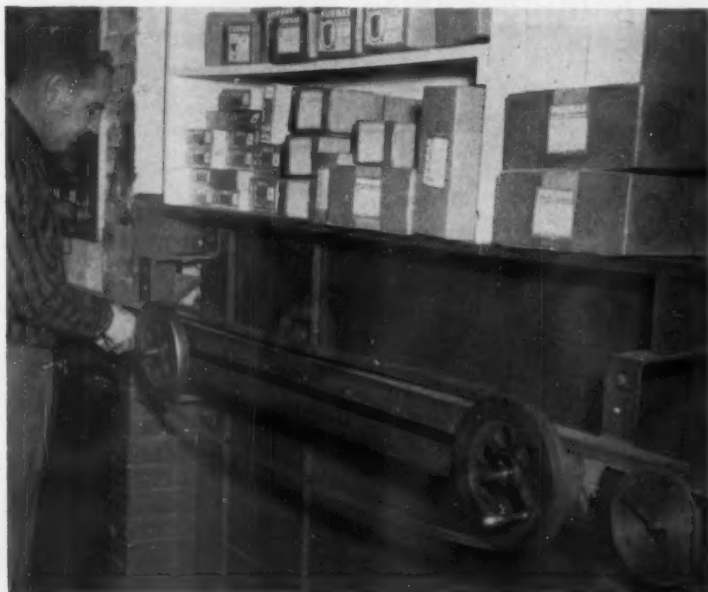
This possible problem is bypassed in the shop of the Pennsylvania Electric Motor Co., Philadelphia, however, because their arbor press is fitted with a curved V-notch collar that can be adjusted to handle all-sized thrust work equally.

As noted in the accompanying photo, this variable-width bearing yoke is pivoted so that the collar can be swung inwards or outwards to provide horizontal clearance distances of any desired width. And, by making the notch curved rather than straight-sided, the center of the collar opening constantly re-



**CURVED V-NOTCH** of pivoted collar provides variable-width bearing surface which remains constantly centered beneath vertical thrust drive of arbor press.

mains beneath the centerline of the overhead press pinion. It will also be noted in the picture that the entire press is mounted on wide metal casters so that, if it is desired to shift the location of the press for any reason, this can be accomplished without too much difficulty.

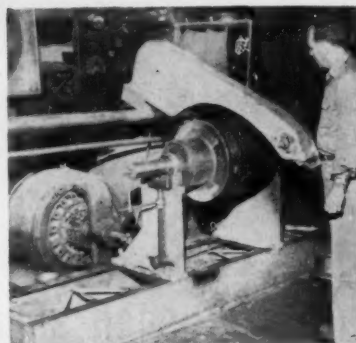


**FIRST-HAND KNOWLEDGE** of technical methods, supply problems, product features, labor relations and service features can only be obtained by "keeping personally in touch" with all phases of motor-service operations, according to Walter J. Burr, vice president of the Electric Maintenance Service Co., Bridgeport, Conn., who personally "lends a hand" to a wide variety of jobs in the office and shop.

## Dynamic Balancer For Large Rotors

Dynamic balancing of rotors up to 50-in. diameter is done on a balancing unit designed and built specifically for large work at the motor repair division of Electrical Engineering and Equipment Company in Des Moines, Iowa. A pivoted, V-belt "drive" can bring rotors up to 1100 rpm; let them spin freely while balance is checked.

Base of the unit is a sturdy steel rectangle of 10-in. channel, 8 ft long and 2 ft wide. The adjustable balancing ways are two 27-in. high sections of 12-in. channel welded to steel pads which bridge and slide along the base. They can be locked securely in position at any predetermined point.

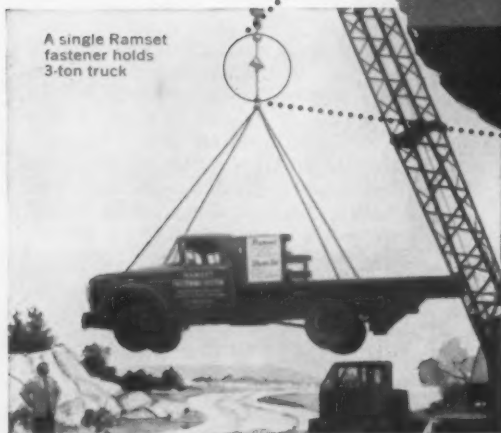


**DYNAMIC BALANCING** unit for large rotors at Electrical Engineering and Equipment Co. shop in Des Moines. Operator lowers "drive" arm to spin rotor to be balanced.

Rotor shafts rest and turn in ball-bearing saddles supported by a 15½-in. high pedestal of 2 ins. by ½ in. spring steel fastened to the base of each way and centered in the upright channel. Each saddle consists of a sturdy metal "box" housing two 3-in., double-row, self-aligning ball bearings. Alignment and sway of the saddle pedestal is controlled by a sliding bracket consisting of a thumb-screw collar on the pedestal bar and two threaded fingers with pressure pads. The collar holds the bracket in any desired up or down position. Tightening the threaded fingers applies pressure against the inside of the channel flanges.

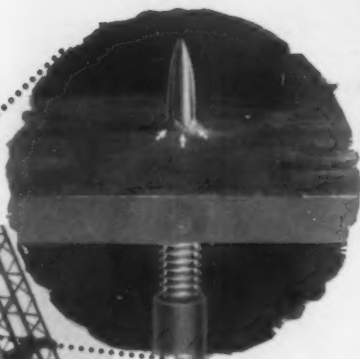
Finer control of back and forth movement of the bearing saddles is provided by knurled threaded bolts in the channel flanges at saddle height. These can be backed-up to permit saddle sway, or tightened to

# ONLY RAMSET

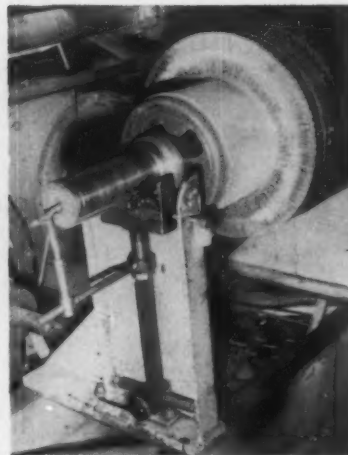


A single Ramset fastener holds 3-ton truck

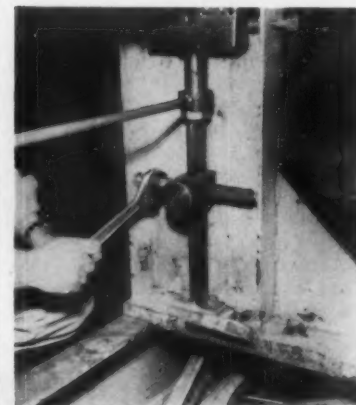
Ramset holding power test conducted by The Austin Co., engineers and builders, Cleveland, Ohio



Spring-like action of compressed steel surrounding the fastener creates a vise-like bond, developing amazing holding power



**ADJUSTABLE WAYS** slide along 8-ft base; have spring-steel pedestal supporting ball-bearing saddle for rotor shaft. Unit takes rotors up to 50-in. diameter.



**PEDESTAL BRACKET** slides up or down; has thumb-screw collar for locking. Tightening threaded fingers (left and right) apply pressure to flanges of up-right channel.

## offers austempered fasteners with such superior holding power

Even under the most demanding workloads, Ramset's austempered Red-Tip fasteners assure more holding power and greater fastener strength. Austempering, Ramset's high-heat slow-quench treatment, puts extra strength, toughness and dependability into every Ramset Red-Tip fastener.

Ramset's wide variety of fastener sizes puts the *right* fastener on each job—you don't have to "make-do" with off-size pins or studs. Ramset assures positive, guaranteed fastenings into tough steel, concrete or masonry faster and easier, and at lower in-place cost. Consider Ramset's many advantages and the "100-for-100" guarantee—call your Ramset dealer (under "Tools" in Yellow Pages) for details.



*In addition to powder-actuated fastening, the versatile Ramset System includes Shure-Set® hammer-in tools for light fastening, and Ringblaster® heavy-duty kiln gun.*

### Ramset Fastening System

WINCHESTER-WESTERN DIVISION • OLIN MATHIESON CHEMICAL CORPORATION  
285-J WINCHESTER AVE. • NEW HAVEN 4, CONNECTICUT

hold saddle in locked position. Normal procedure is to lock the bearing saddle at one end of the rotor shaft while the other end is being balanced.

Adjustable "center-rods" attached to the saddle pedestal, have tapered tips which nest in the "dimple" at each end of the rotor shaft. Their prime function is to eliminate shaft creepage as the rotor spins.

The electric "drive" to spin the rotors is a pivoted V-belt assembly which can be positioned anywhere along the length of the balancing machine. It consists of a 5 hp, 220-volt, 3-phase, 1800-rpm motor driving five V-belts on a cantilever arm. Motor and arm are fastened to a sturdy steel plate mounted to a split collar which slides, and can be tightened anywhere, along a sup-



Unsurpassed  
Mechanical  
and  
Electrical  
Life

## NEW complete line of low voltage motor control

Attractive enclosures of this new line of Size 0 through 4 Allis-Chalmers control *forecast* quality... modern engineering design *assures* it... performance tests *confirm* it. Millions of "life-test" operations attest to the functional quality in every detail — assure the ultimate in dependable performance and sure protection for personnel, motors and machines.

Contact block of glass-filled thermal-setting molding. Contacts of cadmium silver oxide, contact carrier of metal-reinforced molding, dual-voltage coils encapsulated in epoxy-resin — these are just a few of the superior materials used to assure maximum operating dependability and long life.



**Accessibility** — Modern design provides wide-open accessibility for fast and easy installation, modification, inspection and maintenance.

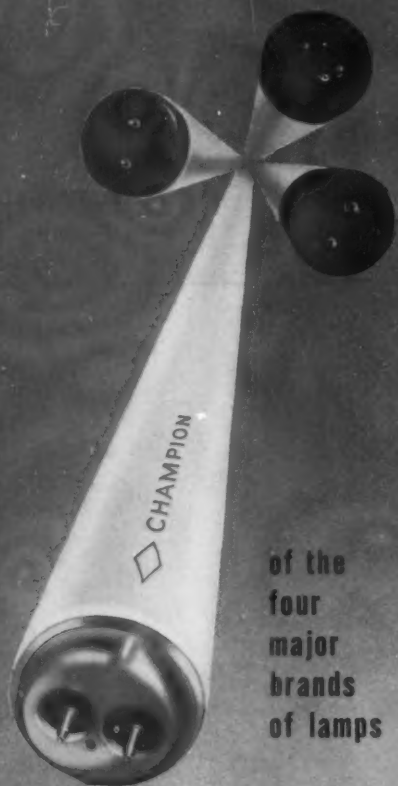
**Flexibility** — Flexible design permits making many modifications in the field with ease. Minimum parts requirements facilitate delivery from local stock.

**A complete line** of low voltage control (Size 0 through 8) and high voltage control in all *NEMA* enclosures, plus engineered control systems. Your A-C distributor or representative will give you all the details. Or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

**ALLIS-CHALMERS**



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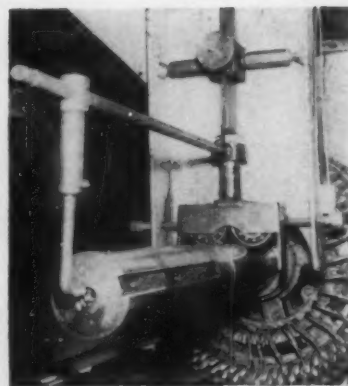
of the  
four  
major  
brands  
of lamps

## CHAMPION stands out for VALUE

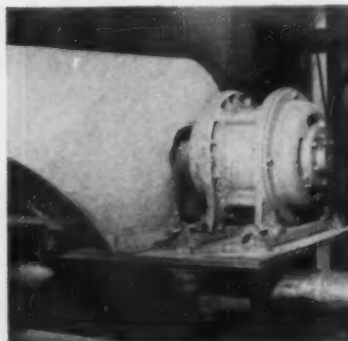
Light/per/dollar . . . the  
measure of value in lamps  
. . . delivered in full meas-  
ure by Champion lamps  
. . . sound reason for  
choosing Champion's as  
your company's best buy.



Incandescent      Fluorescent  
*Your best buy in lamps*



**BEARING SADDLES** each have two double-row, self-aligning, 3-in. ball bearings. Thumb-screws in upright channel control saddle movement. Adjustable "center-rod" at end of shaft prevents shaft creepage.



**BELT DRIVE** assembly, motor and belt-arm, pivots on shaft running length of machine. Split-collar mount permits shifting drive position as required.



**FINGER-TIP** control of drive motor is provided by pushbutton at end of belt-arm. Note convenient handle above button.

porting shaft at the back of the balancing machine. A metal hood covers the top of the V-belt assembly.

After shaft saddles have been adjusted, the operator starts the driving motor. A pushbutton at the tip of the counter-balanced arm provides finger-tip control. He slowly lowers the arm until the belts con-

CHAMPION LAMP WORKS, Lynn, Massachusetts



*For the U.S. Army Missile Master—*

# Where Reliability is a Command:—

S&C Metalclad  
Switchgear is  
used on the  
primary power  
supply

At Fort George G. Meade, Maryland, this vital electronic installation collects information on the location of aircraft, presents this information on displays for decision, and then distributes selected data to Nike missile batteries in a large defense area. The high-voltage power supply for the radar and electronic devices uses S&C Metalclad Switchgear for primary protection and switching.

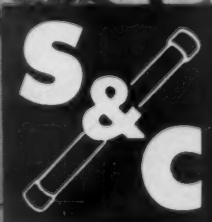
Specified as part of this ultra-reliable nerve center of the Nation's defense are S&C Metalclad Switchgear units, using Power Fuses and Load Interrupters. See inset, left.

Such installations will be used in many areas throughout the United States, where Nike installations protect population and industrial centers.

For further information about S&C Metalclad Switchgear, write to S&C Electric Company, 4439 Ravenswood, Chicago 40, Ill.

Missile Master Power Substation showing S&C Metalclad Switchgear. The principal contractor: The Martin Company, Orlando, Florida, with Airborne Instruments Laboratory, American Machine & Foundry Company.

Specialists in  
High-Voltage  
Circuit Interruption  
for Utilities  
Since 1910



## METALCLAD SWITCHGEAR

# Conduit Holes in Seconds with Greenlee Hydraulic Punch Driver



**for all sizes of conduit up to 5"**

Here's the fast, cost-cutting way to enlarge knockouts or make entirely new openings for conduit up to 5". With a few easy strokes of the handle the GREENLEE No. 7646A Hydraulic Knockout Punch Driver punches through metal up to 10-gauge. Makes hole-cutting in tight, cramped quarters far easier . . . no wrench space needed. This lightweight, portable unit is designed to drive all standard GREENLEE knockout punches for  $\frac{1}{2}$ " through 5" conduit. Comes to you complete with hydraulic pump, hose, ram, adapter screws, and die sleeves in metal carrying case. Ask your distributor for a demonstration of this timesaving tool, or write for Bulletin E-274.

## Wide choice of sets with Hydraulic Driver and Greenlee Knockout Punches


**Set No. 7310 (right)** — Driver and set of 10 GREENLEE Knockout Punches for  $\frac{1}{2}$ " - 4" conduit. Two metal cases.

**Set No. 7306** — Driver and set of 6 GREENLEE Knockout Punches for  $\frac{1}{2}$ " - 2" conduit. Metal case.

**Set No. 7304** — 4 GREENLEE Knockout Punches for  $2\frac{1}{2}$ " - 4" conduit. Metal case.  
**Knockout Punch No. 743** — For 5" conduit.



A COMPLETE LINE OF KNOCKOUT TOOLS, HAND OR HYDRAULIC PUMP OPERATED

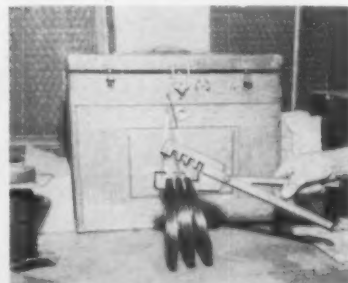
**GREENLEE TOOL CO.**   
1756 Columbia Ave., Rockford, Illinois

tact and spin the rotor to be balanced. Once the rotor "comes up to speed," the arm is lifted, motor is shut off and the balancing procedure begins. After the required weight is added or removed from one end of the rotor and balance is achieved, the process is repeated for the other end.

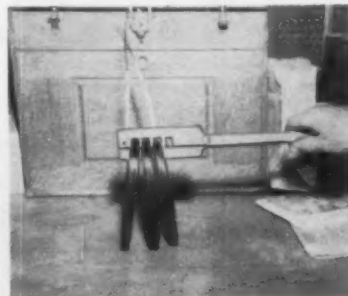
## Fiber Scissor Clamps Hold Group-Wound Coils

Keeping the turns of group-wound coils bunched for tying after removal from the coil form is no problem in the motor repair department of Electrical Engineering & Equipment Company, Des Moines, Iowa. Shop mechanics have developed a set of fiber scissor-type clamps that keep the multi-turn coils separated until tying is completed. The clamp is placed on the coil group as it is removed from the winding head and locked shut to keep individual coil turns separated.

The two halves of a typical clamp are cut from a 16-in. section of  $\frac{1}{4}$  in. fiber. Each is about  $1\frac{1}{2}$  ins. wide at the jaw which is  $5\frac{1}{2}$  ins. long; tapers to  $\frac{3}{4}$  in. width for the  $10\frac{1}{2}$ -in. handle. Four rectangular slots, each  $\frac{1}{2}$  in. wide and  $\frac{1}{8}$  in. deep, are cut in the inner edge of the jaw to seat the



**OPEN CLAMP** seats and separates turns of individual coils in bottom slots. Lightweight fiber clamp is attached when coils are removed from winding head.



**IN CLOSED** position, top slots overlap bottom ones, effectively trap coil turns for tying. A pin through holes in end of jaws locks clamp shut.

individual coils of the group. The halves, with slots facing each other, are pin-hinged at the base of the jaws to provide the scissor action.

In open position, the coil turns nest in the slots of the bottom half of the clamp. In closed position, the slots of the top half overlap those of the bottom section to assure effective permanent separation and bunching of individual coil turns.

## Motor Moisture Damage Largely Preventable

As a result of a statistical analysis of motor failures occurring in all types of plants under their jurisdiction, the electrical division of a large industrial insurance company recently announced that over 13% of all such failures had been caused by moisture.

This high percentage of failures due to a single cause prompted the company to review hundreds of case histories, with the twin objectives of (1) improving their inspection methods and (2) devising a set of recommendations intended to reduce the number of motor failures occurring in the future.

Since the recommendations are designed to lessen insurance rates by decreasing the risks, these findings should be of practical interest to all who are concerned with better motor operation and greater effectiveness of maintenance procedures.

As might be surmised, the report indicates that motor failures are most prevalent in such places as paper mills, packing houses, breweries, laundries, food processing and bottling plants, dairies and creameries; that is, in all types of plants where the use of water for process or cleaning purposes is large, or where steam or vapor is high.

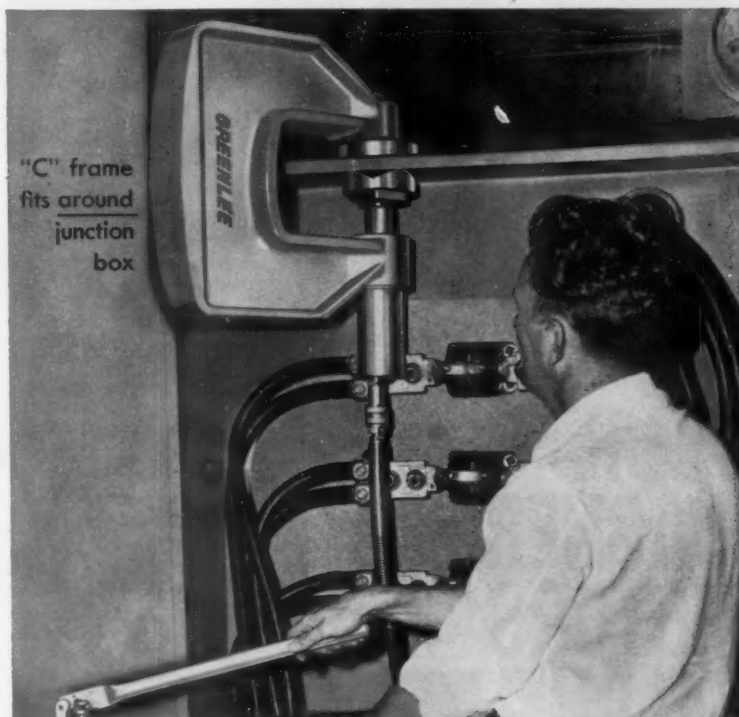
The study also indicated that a large percentage of the failures was due to human carelessness, many resulting from wetting the motors during clean-up operations in plants where cleanliness is essential. Other failures could be accredited to ignorance, where janitorial help had not been advised that water, even in the form of spray rebounding from floors during floor-washing cycles, could be the cause of windings burning out.

Water overflowing from softener tanks, filters, dye tubs and similar liquids reservoirs was yet another category of faults, and it was found that many of these failures could have been prevented if the vessels

# NEW One-Shot

## Hydraulic Knockout Punch Drivers

### Punch Holes for 1/2" - 4" Conduit



### no pre-drilling or step-up punching!

Save many dollars on conduit installations with the new GREENLEE One-Shot Hydraulic Knockout Punch Driver. Lightweight, easy to carry, powerful! Fast one-man setup and operation. 8" deep throat lets you position punch exactly where needed. High-strength aluminum "C" frame provides ample rigidity for slicing through 10-gauge steel with a few strokes of the hydraulic pump. No waste motions . . . fast, accurate work . . . better profits per job!

#### two sizes

**No. 1732** (above) fits all GREENLEE Knockout Punches and Dies 1/2" - 4". Weighs only 35 lb.

**No. 1731** (right) fits GREENLEE Knockout Punches 1/2", 3/4", and 1" with special dies. Weighs only 15 lb.

Both models are used with GREENLEE hand- or power-operated hydraulic pumps. Ask your distributor for a demonstration, or write for descriptive bulletin E-292.



A COMPLETE LINE OF KNOCKOUT TOOLS, HAND-OR HYDRAULIC-PUMP OPERATED

**GREENLEE TOOL CO. GREENLEE**

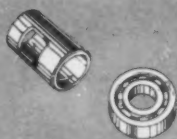
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# KEEP YOUR WAGNER MOTORS ALL WAGNER



**WAGNER  
REPULSION-START  
INDUCTION MOTORS**



**BEARINGS**



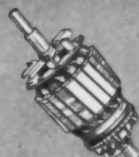
**BRUSHES**



**BRUSH HOLDERS**

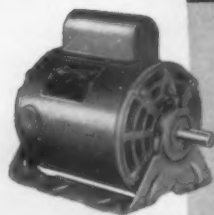


**COMMUTATORS**



**ARMATURE ASSEMBLIES**

It's good business to use genuine Wagner Replacement Parts on every Wagner Motor you repair or rebuild. Good—because Wagner parts fit right and work right, and that adds up to faster work and happier customers. Genuine Wagner Replacement Parts are all top quality—exact duplicates of the original parts. Keep your Wagner Motors all Wagner—and profit by the result.



**WAGNER  
CAPACITOR-START  
INDUCTION MOTORS**



**BEARINGS**

**WAGNER BEARING TOOL**



**CAPACITORS**



**STARTING SWITCH  
ASSEMBLIES**



**SWITCH SLEEVES**



**CENTRIFUGAL  
MECHANISM WEIGHTS  
AND SPRINGS**

## Wagner Electric Corporation

6413 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U.S.A.

OVER 850 AUTHORIZED SERVICE STATIONS OR PARTS DISTRIBUTORS

WR59-3

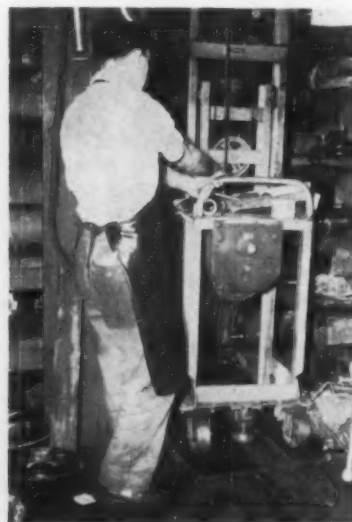
MOTORS • BEARINGS • STANDARD ROTORS • BRUSHES • CAPACITORS • COMMUTATORS

had been equipped with overflow drains. Even in cases where overflow drains had been provided for the tanks, some failures occurred because drains did not discharge into adequate lead-off channels.

This group of failures, caused either by carelessness or ignorance, indicated that greater attention should be devoted to (1) personnel training, (2) relocation of equipment, (3) greater protection of equipment that cannot be conveniently shifted, or (4) the installation of totally enclosed motors.

Another group of accidents could have been reduced by better maintenance programs, programs which would have easily paid their way by eliminating expensive production stoppages and repair costs related to motor breakdowns.

One frequently encountered source of trouble in this category concerned leakage at packing glands of motor-driven pumps. Other failures occurred as a result of damp atmospheres in poorly-ventilated rooms or pits, where leakage from such devices as boiler feed pumps, condensate equipment or similar apparatus had contributed a high moisture content to the surrounding air. Still other failures could be traced to water dripping through holes in the flooring directly above the motors. This group of accidents could have been prevented by better "housekeeping," or by the



**WIDE STEEL STRIPS** secured over floorboards in aisles of Lange Electric's Baltimore shop prevent wear and tear in these heavy-traffic areas. All mobile rigs, such as this small hoist, are mounted on casters to facilitate movement, plus wheel- or floor-pressure locks to insure stability when rolling equipment is positioned in desired locations.



correction of poor existing mechanical and structural conditions.

In addition, the report showed that failures had occurred due to breakage of water pipes, failure of roof drainage ducts, or flooding due to choked sewer drains. While these causes cannot be allocated directly to electrical maintenance, they indicate that electrical maintenance personnel should be alert to all contributory possibilities towards motor failures.

Another repetitive cause for failures indicated that motor windings had become damp due to prolonged periods of idleness, particularly in plants where operation cycles were seasonal, and these windings had not been properly dried before operations were resumed.

Such moisture absorption, even when motors were located in normally damp climates, could have been minimized by keeping machine temperatures above condensation levels through the use of electric space heaters, which are obtainable in various capacities and can be installed quickly and economically. Such heaters should preferably be placed beneath motors, oriented so that heat distribution is even along the entire length of the machine being protected. Of course, when drying motors in this manner, precautions should be taken against the possibilities of overheating and resultant fires.

To estimate the amount of heat required to raise winding temperatures of enclosed (except for small circulation vents at top and bottom) motors to approximately 5 degrees above the ambient, one can use the formula:  $H = DL/35$  . . . where H is the required heat in kilowatts; D is the end-bell diameter of the motor, measured in feet; and L is the stator length, likewise measured in feet, between end-bell centers.

These various preventive measures are obviously applicable to existing conditions and already-installed motors. However, when contemplating the installation of new equipment, their adoption is urged even to a greater extent.



**EXTENSION HANDLE** of hex rod brazed onto a regular Allen wrench makes a handy tool for working out Allen screws in otherwise inaccessible spots on and around motors and driven machinery.

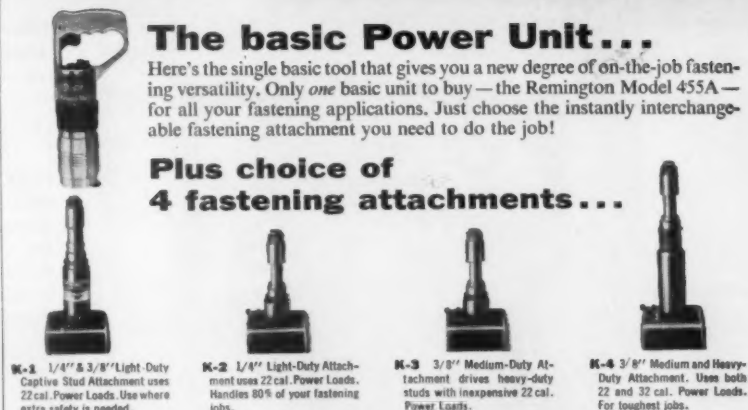
## Remington Stud Driver



### The basic Power Unit . . .

Here's the single basic tool that gives you a new degree of on-the-job fastening versatility. Only *one* basic unit to buy — the Remington Model 455A — for all your fastening applications. Just choose the instantly interchangeable fastening attachment you need to do the job!

### Plus choice of 4 fastening attachments . . .



**K-1** 1/4" & 3/8" Light-Duty Captive Stud Attachment uses 22 cal. Power Loads. Use where extra safety is needed.

**K-2** 1/4" Light-Duty Attachment uses 22 cal. Power Loads. Handles 80% of your fastening jobs.

**K-3** 3/8" Medium-Duty Attachment drives heavy-duty studs with inexpensive 22 cal. Power Loads.

**K-4** 3/8" Medium and Heavy-Duty Attachment. Uses both 22 and 32 cal. Power Loads. For toughest jobs.

### offers greatest single-tool fastening versatility!

The Remington Stud Driver offers these exclusive features:

- Four fastening attachments for light, medium, heavy-duty work, including the special Captive Stud Attachment for extra-safe fastening. No other single tool can cover such a variety of applications.
- Medium-duty fastening—requiring 3/8" studs—can be done with low-cost 22 caliber Power Loads.

- Positive one or two-hand operation at operator's option . . . no buttons or release to hold while fastening.

- Greater variety of applications made possible with instantly interchangeable guards. These 4" square, hollow "safety guards" fit snugly over work, trap spall and dust. More than 40 types are available.

Send coupon for free booklet about the Remington Stud Driver—your best buy in powder-actuated fastening tools!

CHOOSE THE POWER MOST EFFICIENT FOR YOU. REMINGTON POWER TOOLS ARE AVAILABLE IN  
AIR • ELECTRIC • GASOLINE AND POWDER-ACTUATED MODELS

## Remington



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Contractor & Industrial Tools checked below:

☐ Stud Drivers ☐ Air Tools ☐ Chain Saws  
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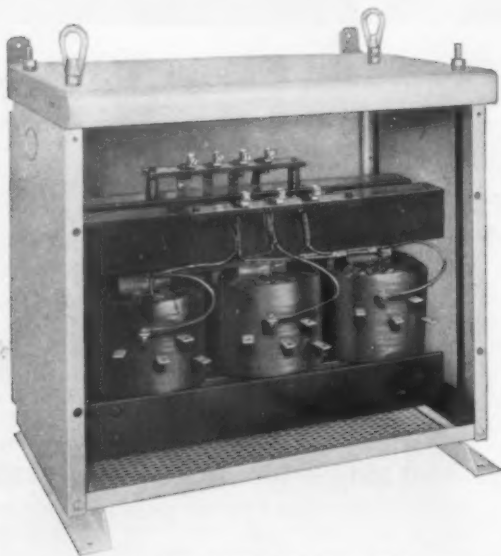
Name \_\_\_\_\_ Position \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

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# When you select dry-type transformers initial costs can be false economy



45 Kva 3-phase transformer with taps. Interchangeable wall or floor mounting. Front panel removed, showing interior.

**COMPLETE LINE FOR EVERY PURPOSE** up to 10,000 Kva, up to 15,000 volts, including special transformers and saturable reactors.

The same quiet SORGEL transformers are also incorporated in substations. Procurable with any type or make of switchgear, or from any electrical manufacturer.

The first cost of dry-type transformers is not always the final cost. Don't be misled; the lure of lower prices often camouflages operating and installation costs. SORGEL SOUND-RATED DRY-TYPE TRANSFORMERS are designed and constructed for long life. They provide the absolute ultimate in operating efficiency, ease of installation, overload capacity and long-range economy.

## **SORGEL offers these proven advantages**

**LOWER COPPER LOSS** — Coils are liberally designed for the most effective use of the latest developments in insulating materials, have large air ducts for low hot spot temperature and are vacuum-impregnated to provide a co-ordinated insulation system.

**LOWER CORE LOSS** — Cores are designed with the industry's lowest magnetic flux densities, resulting in low core loss and the lowest sound level. The entire unit is secured within a substantial frame. Large units are mounted on vibration dampers to minimize vibration transmission to adjacent areas.

**QUICKER AND EASIER INSTALLATION** — The enclosure is self-supporting and entrance can be made on sides, top, bottom or back. Connecting is made easier by means of solderless connectors on terminal blocks in roomy connection compartments. Units up to 75 Kva single phase and 45 Kva 3-phase, are furnished for interchangeable wall or floor mounting.

*Over 43 years experience in the development, manufacturing and application of transformers, has made these achievements possible.*

You will be doing your company or customer a great service when you select the best dry-type transformer made only by . . .

***Sorgel Electric Company***

836 W. National Avenue, Milwaukee 4, Wisconsin

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Consult the classified section of your telephone directory or communicate with our factory.

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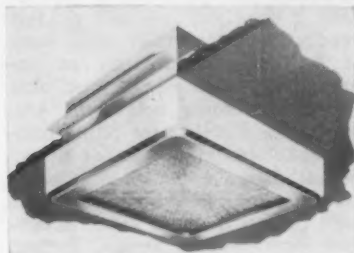
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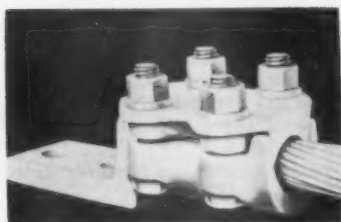
# Product News



**Lighting Fixtures (1)**

New "Semi - Recessed - Shallow" Brascolite lighting fixtures are designed to solve the shallow plenum ceiling problem. "SRS" incandescent units are used in corridors, halls, lobbies, under ducts, pipes, etc, requiring 3- to 4-in. recessing depths. Units feature an Alzak processed aluminum reflector for optimum light control. "SRS" surface boxes are finished in white permalux enamel with contrasting Silvan flange and door. Listed by UL.

Edwin F. Guth Company, 2615 Washington Blvd., St. Louis 3, Mo.



**Terminals (2)**

A line of terminals for cable-to-flat connections to aluminum or copper in wide ranges of sizes has been introduced. Eight terminal sizes cover every cable size from No. 8 through 2000 mcm copper and aluminum or 1780 mcm ACSR. With recessed bolt head pockets for one-hand installation, terminals are designed to make heavy-duty connections.

Burndy Corporation, Norwalk, Conn.

**Rectifiers (3)**

Two new lines of 250-volt dc silicon rectifiers for heavy-duty steel mill and industrial applications, and the other for general purpose operations. Heavy-duty rectifiers are available in 400-, 500-, 600-, 750-, 1000- and 2000-kw ratings with

standard sizes carrying 100% continuous loads, 125% current loads for two hours, or 200% for one minute. The 150- to 300-kw general purpose rectifiers are designed for crane, hoist and general shop service, elevator supply, machine tools with dc motors or control, magnetic chucks and lifting magnets, etc. Single factory-packaged units are available in ratings of 150, 200, 250 and 300 kw and for 3-phase, 60-cycle primary voltages of 208, 240, 480 or 600. A newly developed electrically-operated drawout single-pole breaker in the dc breaker section provides high-speed feeder protection. Bulletins are available.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.



**Transformers (4)**

A new line of pad-mounted distribution transformers permit user to locate all wiring underground. Compact size makes it possible to install transformers in restricted space and screen them from view with shrubbery in housing developments, shopping centers or elsewhere when desirable. They are available for single or 3-phase service.

Standard Transformer Co., Warren, Ohio

**Tray (5)**

New Type "E" tray for continuous support of control and power cables, and tubing. Slot opening is 2 ins. with turned down edge all around. Furnished in galvanized steel and aluminum. Type "E" is interchangeable with P-W's ladder, expanded metal and solid trays. Catalog No. 858 is available.

P-W Industries, Inc., 11200 Roosevelt Blvd., Philadelphia 15, Pa.



**Floodlight (6)**

Type ADED-12 floodlight is a cast aluminum unit designed for fixed mounting in Class II, Group G hazardous locations. Floodlight and its junction Condulet are dust-ignition-proof. Junction box cover supports floodlight, and can be rotated for horizontal aiming. Aluminum housing is corrosion-resistant; door is hinged to case and provides weatherproof fit.

Crouse-Hinds Company, Syracuse 1, N. Y.



**Floor Boxes (7)**

A new line of electrical system floor boxes called Catalog Series No. 88 are designed for conduit installation in the floor surface to accommodate the telephones, intercommunications, light and power. Floor box units are an assembly comprised of a special 4-in. octagon outlet box, threaded outlet box cover, bronze adjusting ring and bronze floor plate with removable insert. The '88' series range in overall height from a minimum 2½ ins. to 3½ ins.

Steel City Electric Co., 1207 Columbus Ave., Pittsburgh 33, Pa.

# LIGHT DUTY

**paper  
electrical  
tape**

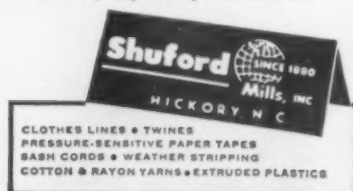


## SHUFORD'S SHURTAPE® EP-33

Economical to use, multi-purpose Shuford's SHURTAPE EP-33 features high dielectric strength and excellent resistance to water and abrasion. Tan in color. Also available in black (EP-33).

Conforming easily to irregular surfaces, it can be effectively used for light duty splicing, as harness wrap and for light duty general electrical purposes. Has relatively low moisture vapor transfer rate. Strips clean. Thermo-bonding.

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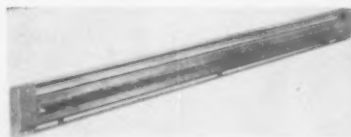


### Motor Starter

(8)

A completely re-designed medium-voltage ac motor starter for a wide range of commercial and industrial applications, called Limitamp Control. Controller features a new draw-out contactor and fuse-shelf assembly. It is designed to provide short-circuit protection and coordinated control for squirrel-cage, synchronous, and wound-rotor motors up to 3000 hp rated from 2300 to 4600 volts. Unit is all-front connected to simplify maintenance. All high-voltage components are automatically disconnected and isolated from incoming line and bus before enclosure can be entered. All high-voltage compartments are isolated by metal barriers.

General Electric Co., Schenectady 5, N. Y.



### Heaters

(9)

An all-new line of automatic electric baseboard heaters called Infra Flo. Improvements are: combination of infrared radiation and convection heating achieved through the grilled front cover and improved aluminum fin tubing; increased wattage density per inch; cooler surface temperature maintained at 110° to 120° F by a secondary cool air passage between case and reflector. Units, available in lengths from 2 to 12 ft, offer wattages from 500 to 4000 watts, progressively, in ten standard lengths.

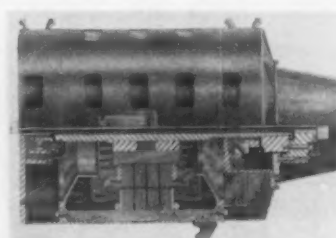
Electro-Ray Manufacturing Co.,  
Vancouver, Wash.

### Cable Support

(10)

A new type "CV" cast aluminum cable support for use with all types of cables and designed to provide both a raintight seal and conduit ventilation for vertical runs. Body of support accommodates an impregnated hardwood wedging plug which sits down below the top, forming a chamber for filling compound. Ports at bottom of fitting permit free circulation of air inside conduit. Type "CV" may be used for one or more wires in conduit sizes ranging from 2 ins. to 5 ins. Literature is available.

O. Z. Manufacturing Co., Inc.,  
Brooklyn 17, N. Y.

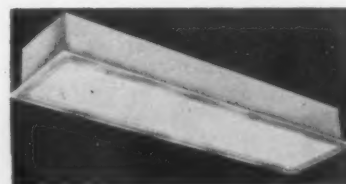


### Motors

(11)

New high speed squirrel cage induction vertical motors in all types of enclosures are offered in 150 hp and up, frames 584 and larger, and are especially suited to unattended, intermittent-duty installations. All rotors are dynamically balanced. A choice of three types of couplings are available.

Ideal Electric and Manufacturing Co., Mansfield, Ohio.

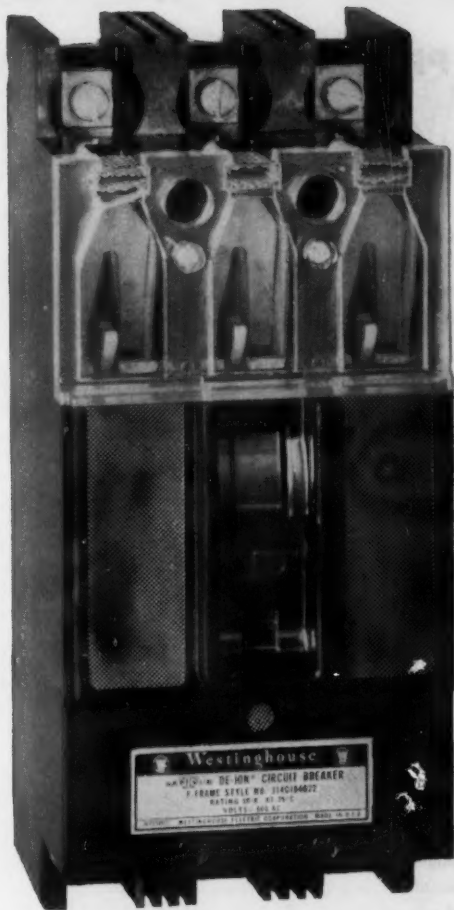


### Troffer

(12)

A new troffer with extruded aluminum frame and door has been developed for use in exterior locations requiring weather resistant construction. The "Gibraltar" series is available in four standard sizes of 1 by 4 ft, 1 by 8 ft, 2 by 2 ft and 2 by 4 ft. Standard diffusers are acrylic plastic or heat resistant glass. Adaptable to wide variety of ceiling construction. Folder G-60 is available.

Gruber Brothers, Inc., 90 South  
First St., Brooklyn 11, N. Y.



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## SAF-T-VUE CIRCUIT BREAKER

**You can see the  
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- Saf-T-Vue\* offers breaker convenience with maximum safety.
- Saf-T-Vue is suitable for use where plant safety codes require visible contacts.
- Saf-T-Vue is available in frame sizes E, EH, F, G, J, JK, K, JKL, KL and LM. Only from Westinghouse can you get the right breaker for every application.

For complete information on this new Westinghouse development, contact your nearby Westinghouse sales office or distributor, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pennsylvania. J-30308

\*Trade-Mark

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# Westinghouse

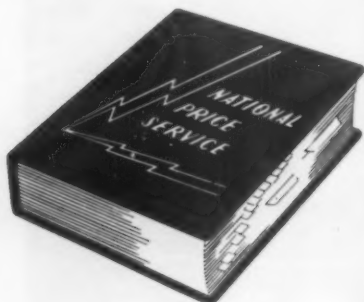
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Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_



13601 EUCLID AVENUE • CLEVELAND 12, OHIO



### Safety Switch

(13)

The QMQB safety switch is a new line of heavy-duty switches incorporating the quick-make, quick-break principle. Rated from 400-through 1200-amp, and having a 100,000-amp interrupting capacity when current limiting fuses are inserted, the switches were developed to meet the increased need of industrial plants and commercial buildings for equipment able to handle larger units of power. QMQB safety switches rated at 400- or 600-amp are normally assembled to take single fuses, 800-amp units to take parallel 400-amp fuses, and the 1200-amp units, parallel 600-amp fuses. Single fusing on the 800- and 1200-amp units is also available on order. Three sizes of enclosures are available.

Federal Pacific Electric Co., Newark, N. J.



### SE Switch

(14)

A new 200-amp service entrance switch for use in outdoor installations such as farms, ranches and trailer parks. It can be changed over to 400-amp service by adding a conversion unit.

Midwest Electric Products, Inc., Mankato, Minn.

### Time Switches

(15)

An early-rising feature, for Winter use, has been added to Tork astronomical dial time switches. Device now makes possible automatic lighting from 6:00 a.m. to dawn without need for maintaining all-night lighting. When sunrise occurs before 6:00 a.m., no ON action takes place.

Tork Time Controls, Inc., Mount Vernon, N. Y.

### Cover

(16)

A solid aluminum weatherproof cover with a positive "stay-open stay-shut" action. Lid flips open with a flick of the finger and stays open. Flip lid will take any switch, any receptacle, singly or in combination. Meets both REA and Federal Specifications.

Slater Electric & Manufacturing Co., 45 Sea Cliff Ave., Glen Cove, N. Y.



### Heat Pump

(17)

A new air-to-air 5-ton heat pump, RHP-53, is equipped with a new "supersensitive control system" that senses the outdoor temperature and regulates the indoor temperature accordingly. A split-system heat pump, unit has separate indoor and outdoor sections, and is equally adaptable to both residential and commercial applications. Indoor section is designed for flexibility of installation since, with its modular construction, it can be assembled for vertical, counterflow or horizontal flow of air. Indoor section uses a large, squirrel-cage blower with a rubber-mounted motor for quiet operation. This blower can be set for automatic or continuous operation.

Westinghouse Air Conditioning Division, Westinghouse Electric Corp., P. O. Box 510, Staunton, Va.





# PREVENTS NUISANCE TRIPPING **AMBIENT-COMPENSATING BREAKER**

**No worry where extreme  
 temperature changes exist**

- Ambient compensation prevents the breaker from derating the conductors.
- Ambient compensation provides insurance against current interrupting due to false high-temperature influences.
- Ambient-compensating breakers, exclusive with Westinghouse, are available in all frame sizes. Only from Westinghouse can you get the right breaker for every application.

For complete information on this new Westinghouse development, contact your nearby Westinghouse sales office or distributor, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pennsylvania. J-30309

Westinghouse . . .

Pioneer, Developer and Leader of the Circuit Breaker Industry

**YOU CAN BE SURE... IF IT'S**

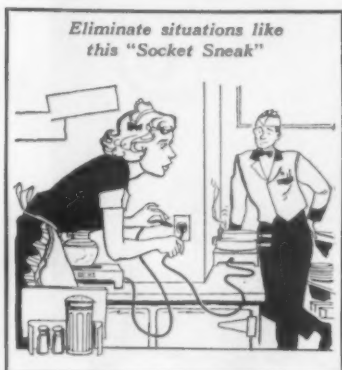
## **Westinghouse**

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

# PLUGMOLD®

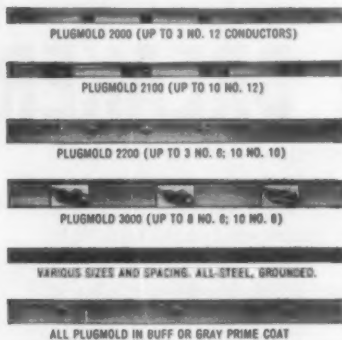
## GIVES MORE OUTLETS FOR LESS MONEY

Easy installation on any surface gives lowest-cost way to provide lots of outlets wherever desirable. Planning flexibility, simplicity of later additions of circuits or outlets, also help make PLUGMOLD easy to sell. Get it from your distributor.



## WIREMOLD®

THE WIREMOLD COMPANY • HARTFORD 10, CONN.



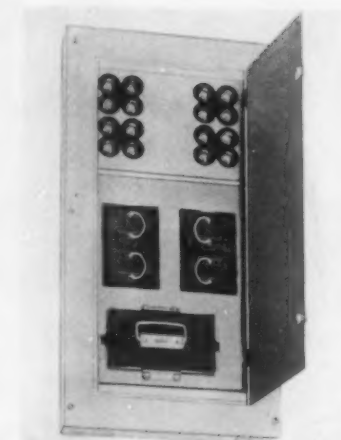
The Wiremold Company, Hartford 10, Conn. E10  
Please send FREE PLUGMOLD DATA to:

Name \_\_\_\_\_

Company \_\_\_\_\_

Street \_\_\_\_\_

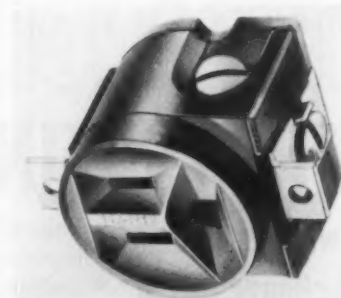
City \_\_\_\_\_ State \_\_\_\_\_



### Service Equipment (18)

New 100-amp fusible main service equipment is complete within itself. The 100-amp main "Renu-Fuse" unit controls all circuits. There are four "Renu-Fuse" pull-covers, three are 60-amp and one 30-amp, or they may be all 60 amp. Device may be had in 8, 12 or 16 plug fuse circuits which may be used for 240-volt heater circuits or 125-volt lighting and appliance circuits. Unit has a deadfront and may be had in surface or flush mounting. It is listed by UL.

Wadsworth Electric Mfg. Co., Inc., Covington, Ky.



### Outlets (19)

A series of new heavy-duty 3-wire grounding outlets with short straps. Each contact is fully enclosed in an individual recess. Face of outlet, No. 5284, is contoured to permit insertion of cap blades. Outlet is available in 125 volts with parallel slots or 250 volts with tandem slots for back and side wiring or for side wiring only. A green hexagonal grounding terminal is located at end of device. Literature is available.

Pass and Seymour, Inc., Syracuse 9, N. Y.

### Pool Heater (20)

Chromalox electric pool heater is fully insulated and furnished complete with limit thermostat, control thermostat in stainless steel well and magnetic contactor rated for heater capacity. It is ready to install in the filter-circulation system. Can be mounted horizontally or vertically. Available for 240 and 480 volts, single or 3-phase operation in a variety of capacities to fit any size pool. Bulletin PE-102 is available.

Edwin L. Wiegand Company, 7500 Thomas Blvd., Pittsburgh 8, Pa.



### Relay (21)

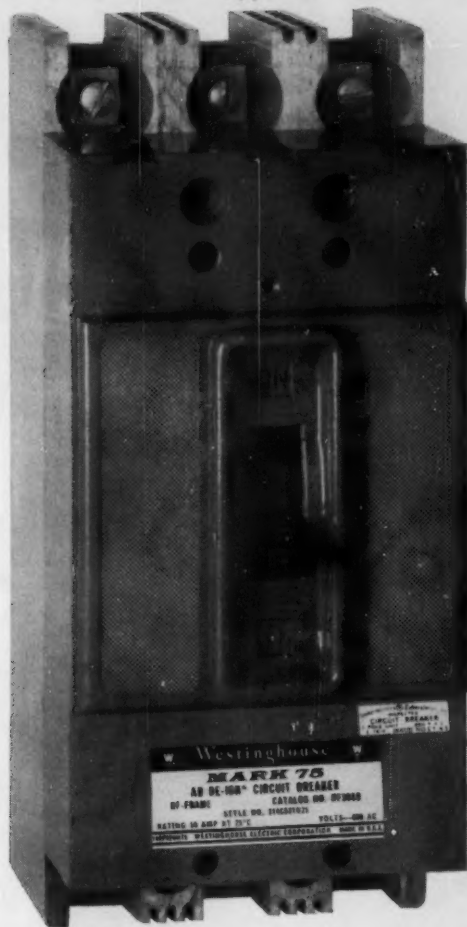
A new high-speed generator relay (Type SA) having all static protective circuit functions providing protection from damage due to 3-phase, phase-to-phase, 2-phase-to-ground, and phase-to-ground faults is available. Relay has a minimum operating current of 0.14 amp through one restraint circuit and the operating circuit in series. Relay is housed in a Flexitest case. Many of the components of the relay are encapsulated.

Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

### Thermostat (22)

Double-pole model, Type 1A66, electric heat wall thermostat is for use in areas where wiring codes require a positive break of both sides of a 240-volt line. Control knob is fully exposed to both room temperature and radiant heat. When knob is set at "OFF" both sides of power line are disconnected. A ground connection is provided. Switch fits any standard 2- by 3-in. outlet box, and mounts flush to the wall, extending outward 1½ ins. Rating is 5000 watts, 240 or 277 volts ac.

White-Rodgers Company, 1209 Cass Ave., St. Louis 6, Mo.



# INTERRUPTS 75,000 AMPS

## MARK 75 CIRCUIT BREAKER

**High interrupting capacity  
in standard frame sizes**

- Mark 75\* breaker is ideal for use in network systems.
- Mark 75 breaker is UL approved.
- Mark 75 breaker is available at only a fraction of the cost of other high interrupting capacity breakers . . . and comes in the same sizes and is interchangeable with the standard line of Westinghouse AB breakers.
- Mark 75 breaker is available now in frame sizes HF, HK, HKL and HLM. Only from Westinghouse can you get the right breaker for every application.

For complete information on this new Westinghouse development, contact your nearby Westinghouse sales office or distributor, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pennsylvania. J-30305

\*Trade-Mark

Westinghouse . . .

Pioneer, Developer and Leader of the Circuit Breaker Industry

**YOU CAN BE SURE... IF IT'S**

# Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV FRIDAYS

# Westinghouse develops new motor starters with “monkey proof” safety features

*Westinghouse NEMA 12 Life-Line<sup>®</sup> combination starters end unauthorized tampering, offer greater safety and convenience to service personnel*

To order simply contact your local Westinghouse representative or distributor now, or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa.

YOU CAN BE SURE...IF IT'S **Westinghouse**

Watch "Westinghouse Lucille Ball-Desi Arnaz Shows" CBS TV Fridays

Check these  
6 great new  
safety "firsts"...

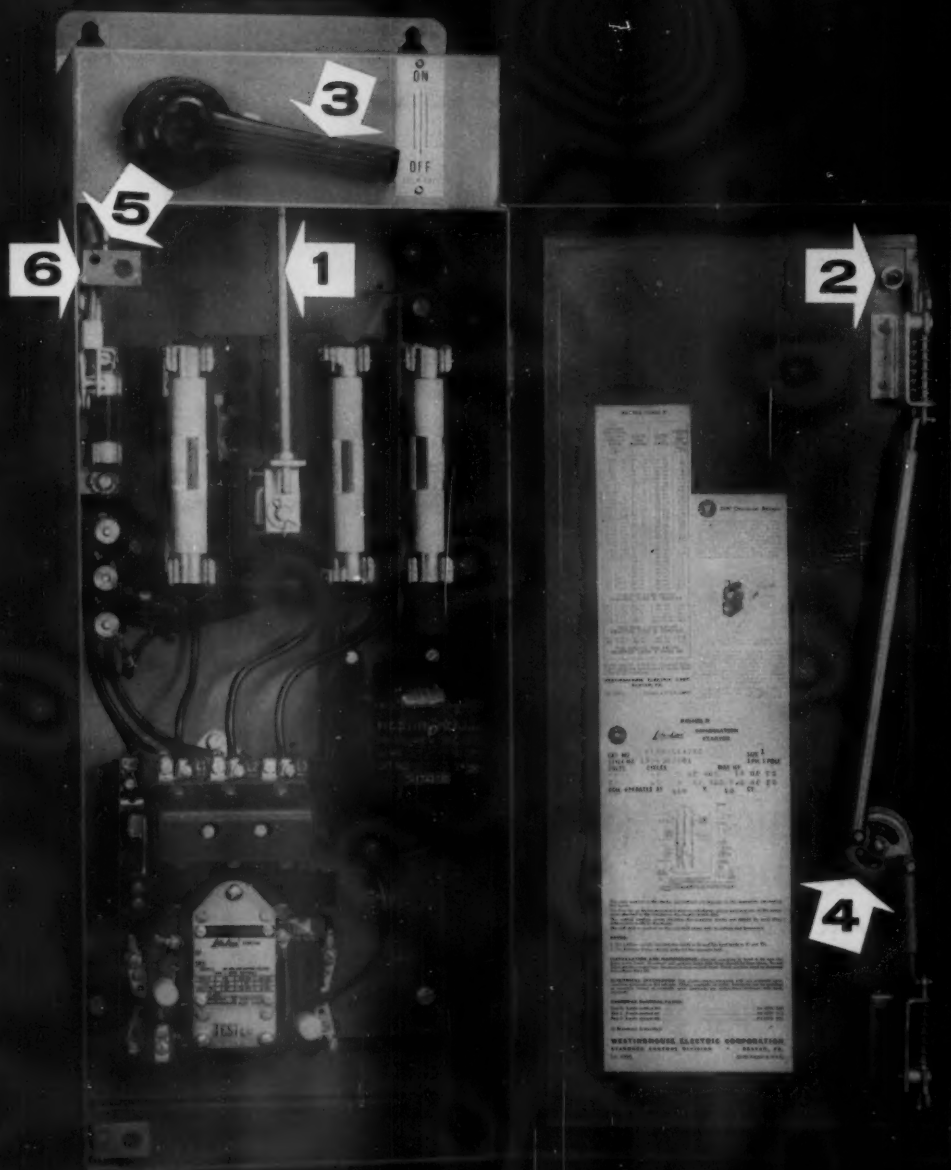
# 123

**SAFE**—You always know whether power is on or off because ON-OFF handle is permanently attached to disconnect...even when door is open.

**SAFE**—Positive gasket seal keeps out oil and dust. An interlock requires that door must be tightly sealed before handle can be moved to ON position.

**SAFE**—Even when you're out of sight, padlocking ON-OFF handle prevents any operation of disconnect regardless of whether door is OPEN or CLOSED.





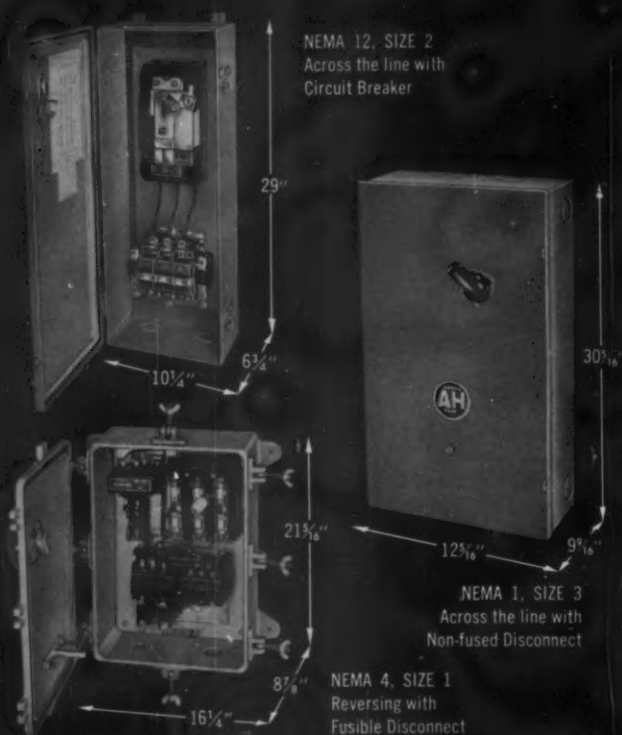
# 456

**SAFE**—Discourages tampering by unauthorized personnel. Tool required to open door.

**SAFE**—Accidental operation of disconnect impossible when door is open. Disconnect interlock must be deliberately voided to operate ON-OFF handle.

**SAFE**—Interlock prevents door from being opened when switch is on. ON-OFF handle must be in OFF position to open door.

J-30306



NEMA 12, SIZE 2  
Across the line with  
Circuit Breaker

NEMA 1, SIZE 3  
Across the line with  
Non-fused Disconnect

NEMA 4, SIZE 1  
Reversing with  
Fusible Disconnect

## Announcing: A COMPLETE LINE OF COMPACT, LIGHTWEIGHT COMBINATION STARTERS

Sizes 0, 1, 2, and New Sizes 3 and 4—and  
NEW CAST ALUMINUM WEATHERPROOF  
and EXPLOSIONPROOF ENCLOSURES

Starters are of exclusive "Right Angle" Design which brings important installation, maintenance and performance benefits. For convenience and safety, unit is front operated by means of Fused or Unfused Disconnect, or Circuit Breaker. Circuit Breakers are Instantaneous or Thermal Magnetic Trip Types. No other line offers enclosures that facilitate mounting and handling like the new cast aluminum NEMA 4 Weatherproof and NEMA 7 and 9 Explosionproof—Enclosures that are one-half the weight of old-style cast iron boxes. Other available enclosures: General Purpose (NEMA 1) and Industrial (NEMA 12—oil-tight and dust resistant).

Write for new folder on A-H Combination Starters to: The Arrow-Hart & Hegeman Electric Company, Dept. ECM, 103 Hawthorn St., Hartford 6, Conn.

**ARROW AH HART**  
*Quality since 1890*

MOTOR CONTROLS • ENCLOSED SWITCHES  
APPLIANCE SWITCHES • WIRING DEVICES



**Magnetic Starter (23)**

Magnetic motor starter, rated through 15 hp, 440-550 volts, incorporates many new control features—all components front removable, dual voltage coils reconnectable on the job, "trip-free" thermal overload relays with trip indicator. Encapsulated dual voltage magnet coils are moisture and fungus resistant and are rated 110-220 or 220-440 volts, 50-60 cycles. Coil accepts plug-in pushbutton or selector switch. Catalog 14-B1 is available.

Furnas Electric Co., 1067 McKee St., Batavia, Ill.



**Concrete Heater (24)**

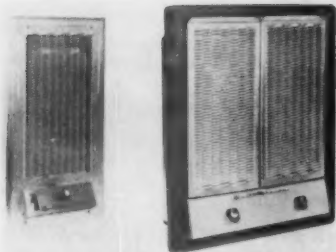
The new Chromalox Thermwire electric concrete heater is a wire mesh, interwoven with electric heating cable and with 10-ft cold leads. Heaters are made 6 or 10 ft long by 18 ins. wide. Installed side by side in sidewalk, heaters will end snow shoveling. Both the 6-ft, 380 watts and 10-ft, 630 watts, operate on 240-volt power supply.

Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa.

**HART**

**AH**

**ARROW**



## Electric Heating (25)

Three completely redesigned models of residential electric heating equipment, consisting of wall, bathroom and floor models. Each unit incorporates a new sloped control panel. Wall models are available in seven sizes from 1000 to 4000 watts operating at 240 volts. Bathroom models have an aluminum grille with an anodized satin finish. Two sizes are available, 1250 or 1500 watts at 120 or 240 volts, with or without Adjust-O-Matic heat control. Floor models are available in 2000-, 3000- or 4000-watt sizes.

Westinghouse Electric Corp.,  
P. O. Box 868, Pittsburgh 30, Pa.



## Floodlights (26)

New line of outdoor power beam floodlights with a spring construction that cuts relamping time. At a touch, a heavy-duty steel coil spring automatically "pops" the old lamp out. New lamps "snap" into place instantly. Floodlights are for up to 300-watt 2000-hr sealed beam lamps and are available with a wide variety of mounting devices for pole top or wall mounting, singly or in clusters. All units are heavy-duty, weatherproof, corrosion-proof die-cast aluminum throughout, and are UL and CSA approved for outdoor service. Bulletin P-110 is available.

Stonco Electric Products Co., 333  
Monroe Ave., Kenilworth, N. J.

# ARROW



# HART

T-1651

T-1652

T-1653



## NEW ARROW-HART HIGH QUALITY WALL PLATES

MADE OF 302 (18-8)

STAINLESS STEEL  
18% CHROME, 8% NICKEL

93071

### NARROW, TRIM-LINE WALL PLATES

**WILL NOT RUST.** Designed for use with H&H Specification Grade Interchangeable Wiring Devices, these slim, trim wall plates are ideal for use in movable metal partitions for industrial or commercial applications. Available with 1, 2 or 3 openings, or blank.

### STANDARD WALL PLATES

Made of the same high quality 302 (18-8) Stainless Steel. Available in a complete line, 1 to 3 gangs.

First to bring you the latest and finest, Arrow-Hart offers you **TWO** new products. Attractive and maintenance-free, these wall plate lines will please your customers and help build your reputation. These new A-H Wall Plates are high quality, high nickel stainless steel. *They will not rust*; will resist most organic chemicals and withstand Salt Spray Tests. Act now to take advantage of this new opportunity to give your commercial and industrial customers the finest in the field. Write today for complete information.

Dept. ECM, The Arrow-Hart & Hegeman Electric Co.  
103 Hawthorn St., Hartford 6, Connecticut

Have You Seen the New Arrow-Hart Combination Starters?

ARROW **AH** HART

Since 1890  
MOTOR CONTROLS • ENCLOSED SWITCHES  
APPLIANCE CONTROLS • WIRING DEVICES

Checked 'em all . . . got  
**Far More for My Money**

when I bought this terrific new

**RIGID 535**

**Pipe & Bolt  
Threading Machine**



Complete with  
**1 Universal Die Head, 2 Sets of Dies**  
for 1/2" to 2" pipe or conduit

Pats. Pending

Looks good, does better. Perfect cutting, reaming, threading fast . . . and easy! Three tools operate independently . . . swing up out of the way for short conduit chucking from front. Slip-proof Speed Chuck is a great performer. Concealed oil system, automatic shut-off nozzle. Quick-opening die head sets to size right in machine. Power? . . . **RIGID**-built motor handles 2" pipe, conduit, bolt, rod —and 12" geared tools easily. Try it, compare it . . . and you'll understand its enormous popularity! Leg and wheel stands available. At your Supply House.

Time-savings  
on just 3 large  
jobs more than  
paid the \$460<sup>00</sup>  
price!



The Ridge Tool Company

Elyria, Ohio, U.S.A.

**THREADED PIPE . . . It's Tight . . . It's Best . . . Costs Less!**



#### Heat Pump

(27)

A new 5-ton, split-system Weathertron heat pump consisting of a weatherized outdoor remote unit, Model WTA60B and an indoor air handling unit, Model WTE60AC. It both heats and cools without fuel or water, is UL approved and rated in accordance with the new ARI standards. The heart of the outdoor section is the G-E high speed compressor, 3450 rpm. The two-tone grey enameled vertical air handler utilizes a 115/230-volt blower motor and the variable-speed, permanently-lubricated, ball-bearing blower is cushion mounted and belt-driven.

General Electric's Central Air Conditioners, Tyler, Texas.



#### Circuit Breaker

(28)

Fully magnetic 200-amp circuit breaker is designed for residential use and available as a main disconnect in a full line of small sized load centers with 20 to 40 circuits. Features include: tungsten silver contacts, two switch positions, immediate resetting, and available in 125, 150 and 175 trip ratings. Boxes are designed with a depth of 3 1/8 ins. Listed by UL.

Murray Manufacturing Corp.,  
1250 Atlantic Ave., Brooklyn 16,  
N. Y.

#### Switch

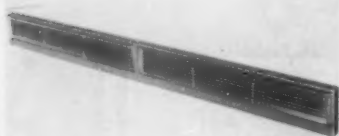
(29)

New single pole weatherproof pilot light-switch assembly, Catalog No. SwP-2, is especially designed for interior and exterior



applications, wherever a moisture problem exists. It will fit a 2-gang "T" box or any 2-gang outlet box. It comes complete with tight-sealing rubber gasket, 6-watt, 125-volt bulb and mounting screws. It is UL approved and meets all Federal and REA specifications.

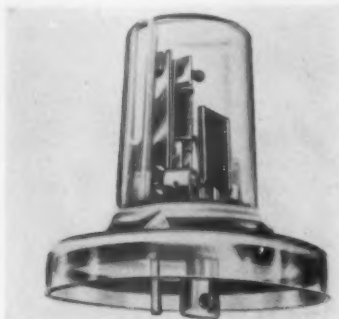
*Perfect-Line Manufacturing Corporation, Old Country Road & RR Avenue, Hicksville, L. I., N. Y.*



**Baseboard Heater (30)**

Radiant glass baseboard electric heater, Model 650B-24, operates on 240 volts and 650 watts. Sections can be joined end to end or at corners where angles are required. Accessory sections available include thermostat section, duplex electrical outlet section and inside corner section. Constructed of anodized aluminum with rust and tarnish-proof brass finish. Heating element is Corning Pyrex glass. Overall size is 7 $\frac{1}{2}$  ins. high, 36 $\frac{1}{2}$  ins. long, 2 $\frac{1}{2}$  ins. thick.

*Allied Precision Industries, 425 Stevens, Geneva, Ill.*



**Lighting Control (31)**

A tubeless photoelectric outdoor lighting control that meets TDJ-148 EEL-NEMA standards is available in either 120- or 240-volt. Control D-2-275 is gasketed, has a polarized twist lock, built-in lightning arrester, and consists of an SPST normally closed integrating relay operated by a wide-area CdS photoconductive cell. The two-component unit is assembled in a transparent weather-proof gasketed housing of Tenite No. 2.

*Precision Magnetic Controls, Inc., Ridgewood, N. J.*

## Cut and Thread Conduit by Hand?

...not me or my men when I can get the new tough fast little

**RIGID 300**  
**Power Drive**

For only \$199<sup>50</sup>

\*Subject to change without notice.



Weights only 79 $\frac{1}{2}$  lbs.  
— all metal!

Pats.  
Applied  
For

**Full Speed...  
even on 2" pipe or conduit**

This new 300 is clear out of its price class! Its RIGID-built motor has extra power and extra-long brush life . . . heavy-duty bump-proof switch . . . RIGID Speed Chuck with guaranteed tight grip, forward, reverse, replaceable jaw inserts and all-metal hand wheel . . . 2 extra-strong tool support bars . . . and a lot of other features that make it far the most for your money. You can't afford to be without it—see and try the new 300 at your Supply House!



No. 1206  
Stand for  
**RIGID  
300**  
\*Price \$27.00



The Ridge Tool Company

Elyria, Ohio, U.S.A.

**THREADED PIPE... It's Tight... It's Best... Costs Less!**

# Fashion Plate

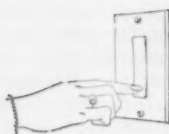
from **BRYANT**



Exciting new idea in wall switches

Lets the builder or owner match, blend  
or contrast any decorating scheme





**TAP-EEZ** . . . new tap-action, flush-mounted switch for buildings, institutions and stores. Rugged enough for all a-c applications, yet much more attractive than ordinary switches.

## WINS NEW CUSTOMERS . . . CAPTURES MORE BUILDER DOLLARS

Fashion Plate opens the door to more business in new construction . . . for homes, buildings, institutions . . . brings you a bigger share of the total building dollar

There's real excitement about Fashion Plate\* among builders and architects. They are taking a second look at wall switches. That means you'll see Fashion Plate in more and more specifications . . . in more and more new homes and buildings. And you are the one who profits.

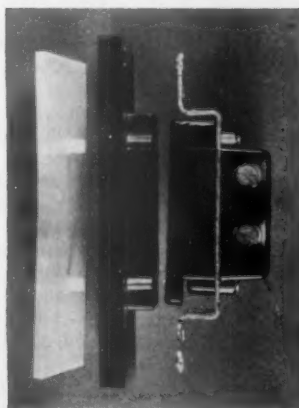
Right now, builders all over the nation are

being supplied with a brand-new merchandising package for Fashion Plate. And they are being sent to you to supply their wiring needs.

Don't wait. Stock up now before the big building rush this summer. Next job you wire, suggest Fashion Plate. It's an exciting new product that wins customers and builds profits.

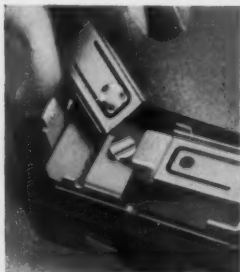
\*Trade-Mark

ASK YOUR BRYANT DISTRIBUTOR for a sample of Fashion Plate. Take it apart and see the built-in quality . . . the trade-mark of Bryant superior wiring devices.

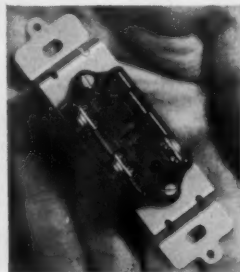


Smooth, quiet action. Low installation cost. Just press on back plate and actuator.

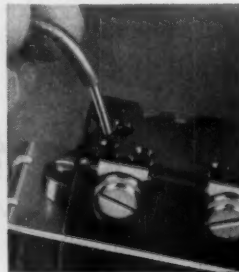
**UNLIMITED APPLICATIONS—AVAILABLE IN SINGLE, DOUBLE AND THREE GANG COMBINATIONS—WITH CLEAR OR IVORY ACTUATORS, BLACK OR WHITE BACK PLATES**



Silver alloy contacts insure long life. Positive controlled contact action. Listed by Underwriters' Laboratories, Inc.



Compact design. Fits standard switch boxes. Requires no special wiring.



Time-saving, clamp-type, back wiring terminals make installation quick and easy.

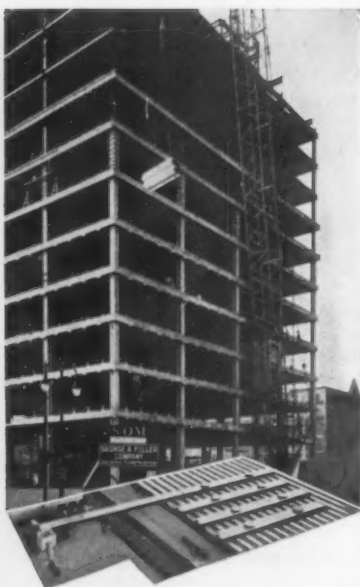
# Fashion Plate

*the exciting things come from*

## **BRYANT**

THE BRYANT ELECTRIC COMPANY, BRIDGEPORT 2, CONNECTICUT

J-09024



More CONDUFLOR headerduct for Rogers Elec. Service, Inc. contractor on new Libbey-Owens-Ford executive offices, Toledo

When designing or bidding Cellular Underfloor Distribution Systems be sure you investigate

## Conduflor\*

— the new, modern floor and ceiling headerduct and fittings system for power, communication and signaling lines.

## Conduflor\*

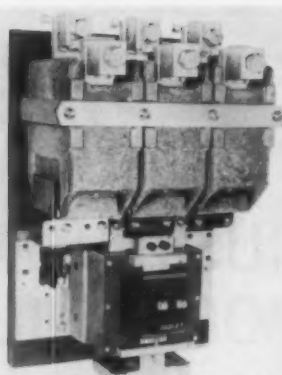
fittings are listed by Underwriters Laboratories, Inc.

Write or call for detailed data file on cellular concrete or steel floors.

CONDUFLOR  
CORPORATION

P. O. BOX 2748  
CLEVELAND 11, OHIO  
Winton 1-6430

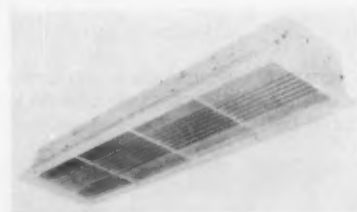
\*trade mark registered



### Contactor (32)

A new 300-amp, standard NEMA Size 5 ac solenoid contactor designed primarily for use in motor starters and controllers, but also recommended for heater and lamp load switching. Heavy inrush currents are handled by double break contacts, enclosed in individual arc hoods. Standard coil voltages are: 110, 208/220, 440 and 550 volts, 60 cycles.

Ward Leonard Electric Co., Mount Vernon, N. Y.



### Troffers (33)

A new series of 18-in.-wide units has been added to the Aurora line of recessed fluorescent troffers. Slimline and rapid start troffers feature a new extruded aluminum diffuser frame with a built-in light trap which seals the troffer interior on all sides, increasing the usable light output. Units are available in a full range of standard sizes from 1 by 2 ft to 4 by 4 ft, using two to eight lamps in a single fixture. They are designed with a standard housing and three optional trims to fit all basic types of ceilings. Bulletin T-759 is available.

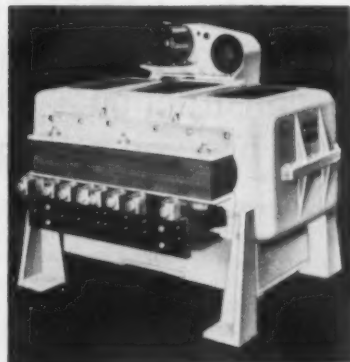
Metalcraft Products Co., Inc., Philadelphia 35, Pa.

### Ballasts (34)

Type EMB explosion-proof ballasts have been designed for use with EV and DL Series Condulet lighting fixtures for hazardous locations. Of the autotransformer

type, these high power factor ballasts operate on 60 cycles, ac, with triple tap primaries that closely match line voltage. Ballasts are supplied for a single 250-watt lamp, or one or two 400-watt lamps. In two-lamp applications, one fixture can be supported directly from the junction Condulet; the second fixture can be supported from a fixture hanger Condulet.

Crouse-Hinds Company, Syracuse 1, N. Y.



### Transformers (35)

Powerstat variable transformers of the H-C series feature high current ratings. Re-entry rings and helical coils permit continuously-adjustable control of 1600 increments over the range of zero to maximum output voltage. Two types are available. Both are remotely operated from a control unit mounted either on the Powerstat frame or at any other convenient location. With an input of 240 volts, 60 cycles, 3-phase the convection cooled type has an output rating of 0-270 volts, 200-amps, 93.5 kva, and the forced air-cooled type has an output rating of 0-270 volts, 360 amps, 168 kva.

Superior Electric Company, Bristol, Conn.

### Diffuser Panels (36)

A new line of "Compatible" diffuser designs—2 by 4 ft, which match the standard 2 by 2 ft diffusers, making possible architectural variations. Units are of new anti-sag construction. Diffusers are available in both single and double dirt-shield panels. Double panels consist of two plastic sheets placed apart and fastened around the perimeter with white or bright metal edge. Light transmission is controlled to give low brightness.

Lightonics, P.O. Box 7211, Oakland 1, Calif.



ALLIS-CHALMERS

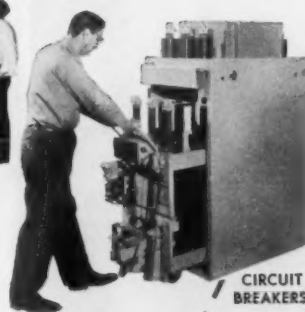
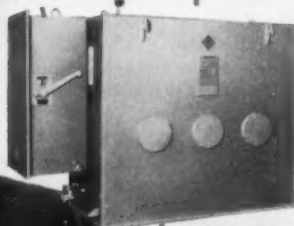
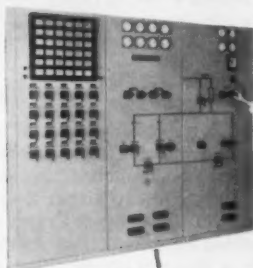
"Profit Line for '59"  
Electrical Products from

**ALLIS-CHALMERS**

**ONE MAN...ONE SOURCE**  
for complete system sales!

Allis-Chalmers electrical system package selling can step up your profits fast! Single-source buying cuts acquisition costs. You make *more* on each product *and* each system. There's just one firm to deal with — unit responsibility for all electrical products and their performance! Scheduled delivery avoids on-the-job delays. Engineered to work together, matched Allis-Chalmers products are easier to install. Ample stocks of spare parts are maintained for speedy product servicing.

**For more profit facts on this key line** (illustrated on the following pages), call your nearby A-C man or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.



ALLIS-CHALMERS



A-1171-EC



## Case of the Missing Outlet Box...

SOLVED by —

ARROW CONDUIT'S

## PLASTER GUARD COVER

for 4" Sq. & 4-11/16" Sq. Boxes



U. S. Pat. No. 2,574,382

- Plaster Guard prevents plaster from entering box.
- Raised section easy to locate after plastering.

Work with cleaner outlet boxes, free from usual plaster fill-in. Raised Plaster Guard section is easy to pry out. Available on all Arrow 4" Sq. and 4-11/16" Sq. covers.

Write for detailed information.

Skill & Experience... active ingredients in all Arrow products.

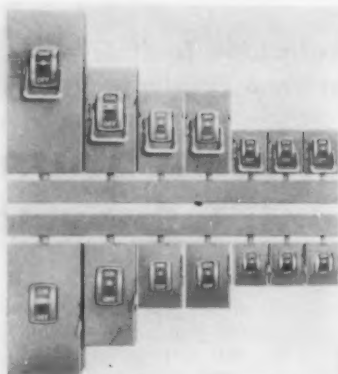
## ARROW CONDUIT & FITTINGS CORP.

129 30th Street, Brooklyn 32, N. Y.

OUTLET BOXES • GANG BOXES • COVERS • BOX SUPPORTS



John H. Thompson & Sons, Inc. • Atlanta, GA. • BOSTON, MA. • CHICAGO, IL. • CINCINNATI, OH. • DALLAS, TX. • DETROIT, MI. • GREENSBORO, NC. • KANSAS CITY, MO. • LOS ANGELES, CA. • MIAMI, FL. • NEW ORLEANS, LA. • NEW YORK CITY, NY. • NEWTON CENTER, MA. • PHOENIX, AZ. • RICHMOND, VA. • RICHMOND, N. Y. • SEATTLE, WA.



## Switches

(37)

Bottom hinging and front operation on new G-E safety switches cuts space requirement for close-ganged installations. These features highlight a new line of 30- through 600-amp light and heavy-duty switches. Bulletin CPD-74 is available.

General Electric Co., Distribution Unit, Plainville, Conn.

## Trencher

(38)

A new trenching tool for installing underground electrical systems, called Pup Trencher, is self-propelled. It will dig either 2 or 3 ins. wide and 3 ft deep. Propulsion is provided by a winching mechanism with a 6-speed drive. Unit can be started, set at a desired depth and be left unattended until it finishes the trench. Guide handle raises and latches into a handle-bar position for portability.

Davis Manufacturing Inc., 1301 So. Handley, Wichita, Kansas.

## Adapter

(39)

When used at the bottom of a vertical conduit riser which is properly vented at the top, a special conduit ventilator adapter, Type "KVF", provides for the movement of cooling air throughout the riser. Standard fittings are of cast aluminum, accommodating conduit sizes of 3, 4 and 5 ins. Fittings are also available in bronze.

O. Z. Electrical Manufacturing Co., Inc., Brooklyn 17, N. Y.

## Voltage Regulators

(40)

Two transistorized electromechanical automatic voltage regulators, designated Stabiline types EMT4104 and EMT4104UT, are now available for applications

where loads up to 8.4 kva must be controlled by a relatively small sized assembly. Both types are designed for either 120- or 240-volt, 50/60 cycle, single phase duty. Data Sheet SE-L3599 is available.

Superior Electric Company, Bristol, Conn.

## Damping Attachment

(41)

A new damping attachment designed for use on Type A oil-tight limit switch. It can be used with any arm. Typical applications include conveyors and automation equipment where precise actuation by means of a cam is not practical. Bulletin 9007-GA is available.

Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

## Cover Plate

(42)

A heavy-duty weatherproof cover plate for 20-, 30- and 50-amp receptacles. Cover plate snaps closed and can be padlocked to prevent tampering. It is designed for use in industrial, railroad, farm, marine, aircraft and commercial applications.

Bell Electric Co., 5735 S. Claremont Ave., Chicago 36, Ill.



## Radiant Heating

(43)

A new method of installing a low-temperature radiant heating system beneath concrete walk or driveway for electric snow removals. Unit, called the Sno-Melter, designed at 42 watts per sq ft, will melt snow and ice. Package consists of pre-spaced thermoplastic insulated resistance wire which is anchored in place on galvanized steel mesh mats 10 ft long and 18 ins. wide. Non-heating lead wires and ground lead are also attached. Preassembled units may be rolled into place. Listed by UL for re-examination service.

Easy-Heat, Inc., Lakeville, Ind.

The Profit Line for '59

ALLIS-CHALMERS

ALLIS-CHALMERS

ALLIS-CHALMERS

Exclusive electrical and manual stored-energy closing mechanism.



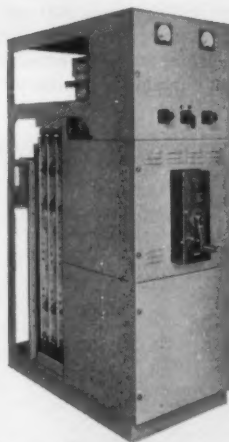
Convenience — control devices located on breaker front—safely available even with door closed.

## Plus Value in every detail

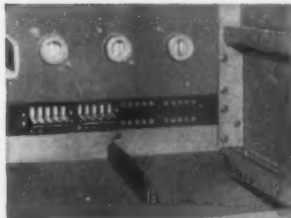
Allis-Chalmers all-new  
600-volt metal-enclosed switchgear  
for 75,000-ampere  
interrupting service

Just a few of the operating... safety... and application features of A-C's new design are shown. There are many other features that will interest you, such as unitized construction, the use of polyester glass insulation, and spring-held dust seals.

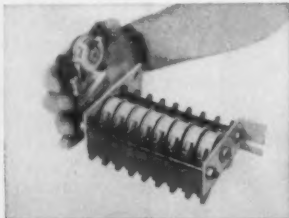
Get the details! Contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.



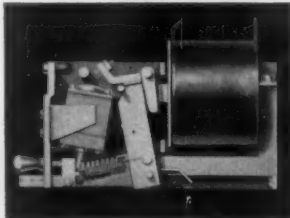
Safety — breaker shown in disconnected position... stored with door closed. The indicators show circuit breaker position.



**Safety**—(a) interlock prevents movement of closed breaker; (b) latch prevents rocking past disconnect position.



**Flexibility**—each stage of auxiliary switch assembly is individually adjustable without disassembly.



**Accuracy**—direct acting series-trip device is set easily, using calibration scale and adjusting knob.



A-1038-EC

# PERFOR

## Number 1 reason why the best bargains

**IN FLUORESCENT LAMPS**, buying on price alone is no bargain at all. (Because the price of the lamps averages only 10% of the operating costs of light.) The other 90% goes for electricity and maintenance. Conclusion? The *best* lamp bargain works your customers' lighting dollar the hardest, gives the most *light* for their money.

How do G-E Fluorescents stack up? Take the popular 4-foot, 40-watt. The new General Electric PREMIUM 3 Lamp, announced in 1959, delivers more light per watt than any previous 4-foot fluorescents. As for maintenance—out of every 1,000 G-E 40-watt fluorescents you sell today, on the average 999 have no defect which can keep them from working—and 990 will still be burning late in 1961! Practically maintenance-free performance like this makes G-E 40-watt, slimline, high output and the exclusive Power Groove Lamps your customers' best bargains in fluorescent light.



**IN MERCURY LAMPS**, you have the source which can give customers the lowest cost of light of any type of lamp commercially available. Lower than filament—often lower, even, than fluorescent. And General Electric Mercury Lamps, at any given time in their life, will outperform any other brand the same age . . . and are built to last as long or longer!

How? In many ways. To name a few—General Electric's dramatic new Bonus Line electrodes, better arc-tube design, and fewer parts to intercept light. And a new 1959 line of six G-E Bonus Line 400-watt Mercury Lamps are the *biggest* bargain in mercury light.

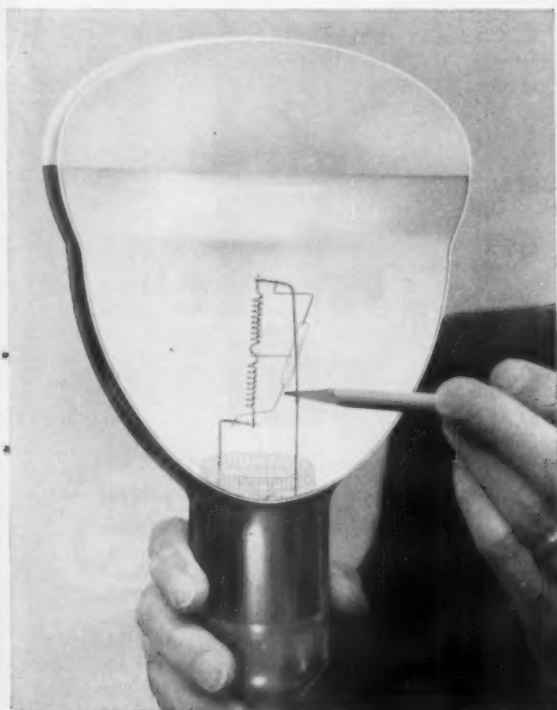
**IN FILAMENT LAMPS** there are some important differences between brands—some of which are detectable even *before* the lamp goes in a socket. Like the new 1959 smaller, brighter, 100-watt lamp bulb that's small as a 60-watter but delivers more initial light than two 60's. Or the new 1959 G-E Quartzline lamps that are pencil-thin but pack up to 1500 watts.

Or like the new 1959 RB-52 Bonus Line 1000-watt reflector lamp shown at right. Special bulge shape distributes heat, so a less-costly, regular glass is used—with savings passed on to your customers. And look! It uses General Electric's stand-up filament that delivers more light than ordinary "draped" type, has more expensive *silver* reflector instead of aluminum. It gives 20-30% extra light on the work plane. Big things are happening in G-E Filament lamps—all pointing to a bigger bargain in filament light for your G-E Lamp customers.



# MANCE

in light are General Electric Lamps



#### IF YOU RECOMMEND REPLACEMENT LAMPS,

then lamp selection is relatively easy. For new installations, however, the job is not often that simple. For this reason General Electric's corps of engineers, technicians and specialists are as near as your phone—to help you help your customers pick the right General Electric Lamp that'll give them the best bargain in light. They'll even aid in recommending the lamp type, size and "color" best for each customer's individual lighting conditions.



**FREE FROM G.E.** Right now... today you can get a startling new 20-page picture paper packed with factual information on lamps and lighting that can help your customers save big money. For your free copy just send your name and address to General Electric Co., Large Lamp Dept. C-931, Nela Park, Cleveland 12, Ohio. Be sure to ask for "FACTS OF LIGHT". See your G-E Large Lamp Representative for larger quantities.

*Progress Is Our Most Important Product*

**GENERAL  ELECTRIC**



## PRACTICAL HELP FOR MEN CONCERNED WITH ELECTRICAL MAINTENANCE

Biddle literature and Biddle Instruments are the universally accepted tools for preventive maintenance programs—they are integral parts of electrical operations everywhere.

Many thousands of copies of the manuals and technical publications, prepared by our engineering staff, are supplied annually to men in industry. In-plant training programs, engineering and trade schools include these down-to-earth discussions of electrical resistance and speed measuring techniques in their courses.

### No File Complete Without These Useful Publications

If you are concerned with the maintenance of important electrical equipment, your files should include practical, dependable information on these subjects:

**Insulation Resistance Testing**  
Manual 21-JECM

**Earth Resistance Testing**  
Bulletin 25 ECM

**Motor & Phase Rotation Testing**  
Bulletin 80 ECM

**Cable Fault Locating**  
Bulletin 65 ECM

**Speed Measuring** Bulletin 35 ECM

Simply list on your company letterhead any or all of these bulletins you would like mailed to you. We will see that you receive regularly Biddle Instrument News.

## JAMES G. BIDDLE CO.

Electrical Testing Instruments • Speed Measuring Instruments  
Laboratory & Scientific Equipment  
1316 ARCH STREET, PHILADELPHIA 7, PA.

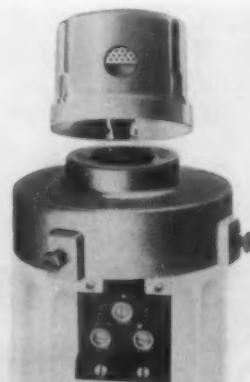


**Motors**

(44)

A new line of integral hp ac motors, called "Duty Master" motors, is available in sizes from one through 250 hp in protected (open), weatherproof, totally-enclosed, corrosion-proof and explosion-proof enclosures. They may be specified in all standard speeds and voltages. Designs include polyphase, ball bearing, vertical and horizontal mounting arrangements. One of the features is the low inertia, fast accelerating rotor, constructed of aluminum. The cast-iron frame of the new open motors protects from dripping or splashing liquids, and has a 40° C temperature rise, continuous duty, with a 15% service factor.

Reliance Electric and Engineering Co., 24701 Euclid Ave., Cleveland 17, Ohio.



**Adapter**

(45)

A new cast aluminum adapter permits fast installation of twistlock photoelectric controls on round or fluted ornamental pole tops. This corrosion-resistant adapter conforms to EEI specification TDJ-148 and NEMA specification SH-18-1959, and will accommodate any twistlock control that conforms to

EET-NEMA standards. It will fit any ornamental pole, round or fluted, up to 4½ ins. O.D. and with an I.D. of 3 ins. or more. Terminals accommodate up to No. 8 stranded wire.

*Fisher-Pierce Co., 170 Pearl St., So. Braintree 85, Mass.*

#### Capacitors (46)

Power factor capacitors are available in two sizes, 25 and 50 kvar, 2400 through 7960 volts. Included in the capacitor package are pole-type racks, stacked racks, voltage sensitive controls, voltage sensitive current compensating controls, current sensitive controls, switches, fuses and other accessories.

*Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.*

#### Control Stations (47)

EWC Series control and indicating stations are designed for use in hazardous areas, indoors and outdoors. Condulets are available in one-, two- or three-gang pushbutton stations, pilot lights and selector switches; and are designed for use in Class I, Groups C and D (NEMA 7), and Class II, Groups E, F, and G (NEMA 9) hazardous locations.

*Crouse-Hinds Company, Syracuse 1, N. Y.*

#### Raintight Enclosure (48)

New 200-amp fusible main raintight enclosure for non-interchangeable and interchangeable breakers. The 200-amp main switches control all of the circuit breakers in the enclosure which may be had in 24, 32 or 40 (15 to 50-amp) single pole breakers. With sequence bus design any two adjacent breaker positions may be double pole. Circuit breaker bus bar assembly is attached to a removable self-aligning metal mounting plate. Dead front is removable type and it is listed by UL.

*Wadsworth Electric Mfg. Co., Covington, Ky.*

#### Pipe (49)

An electrically-heated synthetic rubber pipe, made of Buna-N hard rubber, is heated via a unique non-circuitous silicone rubber heating tape. Pipe will withstand temperatures up to 248°F. Pipe can be manufactured with liners such as silicone rubber, teflon, polyvinyl chloride, metals, and glass.

*Luzerne Rubber Company, Muirhead Ave., Trenton, N. J.*

## SANGAMO TIME SWITCHES GIVE YOU

MORE  
— OPTIONAL —  
FEATURES  
for



## GREATER FLEXIBILITY OF OPERATION

**Need automatic sunset-sunrise operation?** The *Astronomic Dial* automatically controls switching schedules in accordance with sunrise and sunset (or earlier) and compensates daily for the progressive change in seasons.

**Need week-end and holiday scheduling?** The *Omitting Device* permits skipping complete daily operations for any one or more 24 hour periods. Weekly schedules can be repeated automatically.

**Need variation in daily operations?** The *Advance Time Device* used with the omitting device permits an early OFF operation before the last daily OFF operation on any one or more days of the week.

**Need additional daily operations?** *Extra time setting trippers* are available on most Sangamo switches for scheduling multiple operations during any 24 hour period.

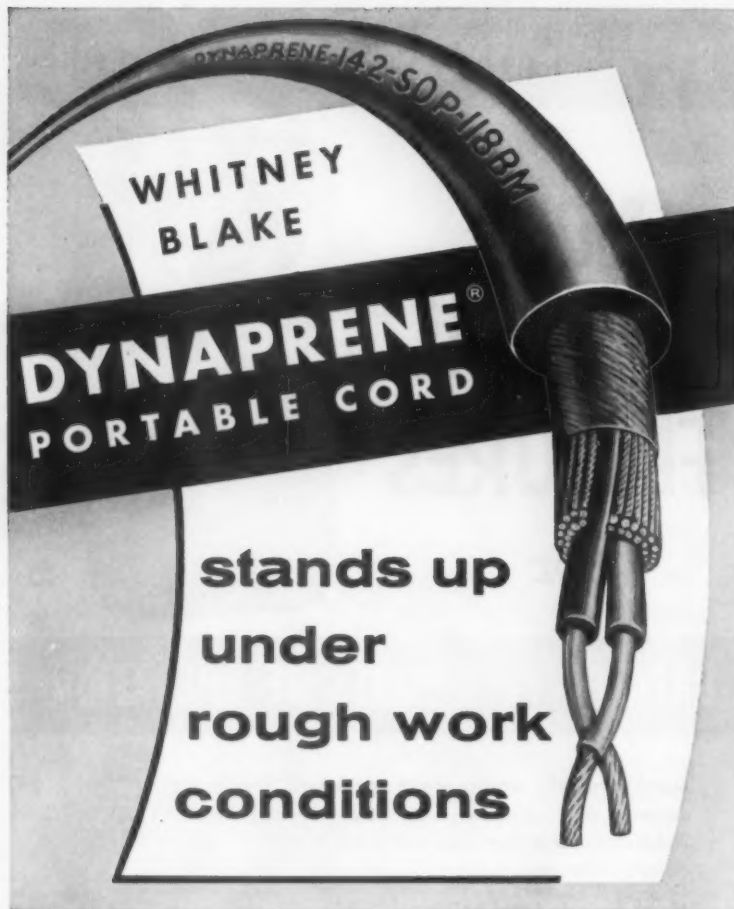
Send for your new catalog  
NOW...

Every time switch is described in detail on an individual product sheet for a ready reference to specifications, enclosure information, available optional features and prices. All sheets are enclosed in the handy file folder shown here. Send for your free copy today!



## SANGAMO ELECTRIC Company

SPRINGFIELD, ILLINOIS



Where portable cord takes a beating because of rugged work conditions, WHITNEY BLAKE DYNAPRENE stands up and gives long, economical service.

DYNAPRENE has an especially tough neoprene jacket, it resists abrasion, has high flexibility and long flex life, and provides premium quality service at competitive prices.



Write TODAY  
for this complete  
catalog . . . FREE.



WELL BUILT WIRES SINCE 1899

**WHITNEY BLAKE COMPANY**

NEW HAVEN 14, CONNECTICUT

## Catalogs & Bulletins

(50) **PLASTIC PIPE** for electrical conduit. 6-page bulletin describes all sizes from  $\frac{1}{2}$  to 6 ins. for such installations as airport lighting, chemical plants, communications, street lighting, and generating stations. Southwestern Plastic Pipe Co.

(51) **AIR CONDITIONERS.** Bulletin 8525, 8 pages, describes design and construction features of packaged units, with tables of physical data and capacities. American-Standard Industrial Div.

(52) **TRANSFORMERS.** New "Do-It-Yourself" Flexiformer, consisting of a packaged primary and no secondary, is described in 8-page Bulletin TP659. Useful for laboratories, classrooms, service shops and inspection departments, the unit permits addition of any number of secondary turns to provide desired output voltage. Superior Electric Co.

(53) **SHALLOW TROFFERS**  $4\frac{1}{2}$  in. deep designed for flush-mounting in ceilings are described in new catalog, including cross-section drawing, specification data and lighting pattern diagrams and tables. Morris Kurtzon, Inc.

(54) **MASONRY ANCHOR** that drills its own hole in concrete is covered in new folder listing typical applications and installation photos. Rawlplug Co., Inc.

(55) **CLASSROOM LIGHTING.** 4-page folder FE presents a 16-point checklist for lighting classrooms and general commercial buildings with the new Versateer series of fluorescent lighting units. Benjamin Electric Mfg. Co.

(56) **UTILITY TRENCHER** that digs by itself, gasoline or electric motor driven, is described in 4-page bulletin DP-1. Davis Mfg. Inc.

(57) **INDUSTRIAL FLUORESCENT** unit with 30x30 louver for VHO, SHO and Power Groove lamps is described with all pertinent specifications in new catalog. AllBrite Div., Curtis-AllBrite Lighting, Inc.

(58) **GROUND DETECTOR.** 8-page Bulletin B74 describes Electronic Sentry mine safety device for protection against ground faults and short circuits on de-operated off-



track mining machines and their trailing cables. Joy Mfg. Co.

(59) **ADJUSTABLE SPEED DRIVES.** Bulletin GEA-6806, 16 pages, describes new  $\frac{1}{4}$  to 25 hp line of Polydyne mechanical drives. General Electric Co.

(60) **GEARMOTOR** from  $\frac{1}{4}$  to 100 hp, both integral and all-motor types. Bulletin 51B9172 discusses design and construction features. Allis-Chalmers.

(61) **CONDUCTOR STRINGING** equipment including utility snatch blocks, pole-mounted brackets and aerial cable blocks are described in new 16-page catalog. Sherman & Reilly, Inc.

(62) **CLIPS AND INSULATORS.** Cat. No. 220 covers entire line from miniaturized clips to welding ground clamps, including newest developments. Mueller Electric Co.

(63) **CONNECTORS** for equipment control. Bulletin 372, 12 pages, discusses neoprene construction designed for application up to 600 volts in oval, round or dual round styles, 2 to 12 poles. Joy Mfg. Co.

(64) **RECTIFIERS.** Bulletins 15B9298 and 15B9432 introduce two new lines of 250-volt dc silicon rectifiers—one for heavy-duty steel mill and industrial applications, one for general purpose operations. Allis-Chalmers.

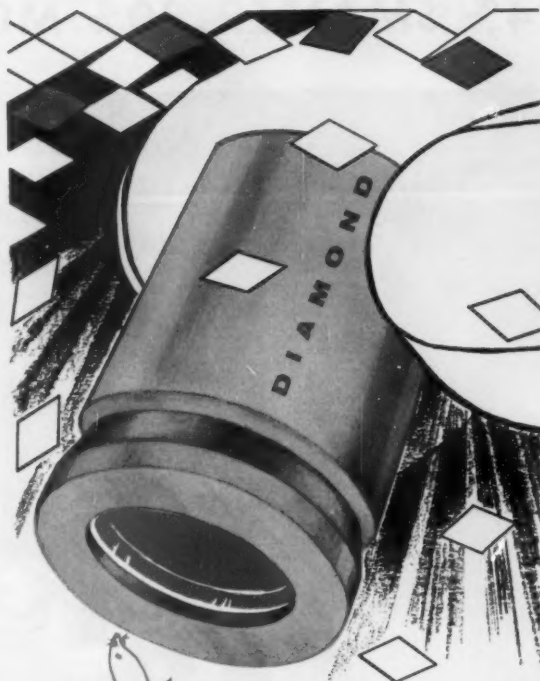
(65) **RELAY GUIDE.** Handy nomograph permits graphical solution to relay problems involving the determination of coil resistance, voltage, wattage, current, acceleration, temperature correction, and release time. Kurman Electric Co.

(66) **ALUMINUM CONSTRUCTION.** Structural handbook, 420 pages, covers completely the use of aluminum for structural purposes. Aluminum Co. of America.

(67) **TRANSFORMERS** for metering. Cat. S-503 describes redesigned line for use with watthour meters and in switchgear. Standard Transformer Co.

(68) **CIRCUIT BREAKERS.** Type FB high-speed current-limiting units in ratings from 1200 through 12,000 amps continuous current at 1000 volts dc are covered in bulletin S-4601-1A. I-T-E Circuit Breaker Co.

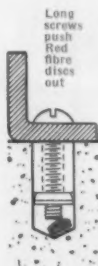
(69) **WIRING DEVICES.** A new abridged catalog listing over 600 items with numerical and subject indexes for contractors, distributors, engineers and estimators. Leviton Mfg. Co., Inc.



**"DIAMOND'S NEW  
Red Seal MAKES  
this SCREW ANCHOR  
BETTER than ANY.**

**—RED FIBRE DISC KEEPS  
DIRT OUT of THREADS and  
INDICATES BOTTOM for  
CORRECT INSTALLATION,"**

**says J. A. Wright, Vice Pres.**



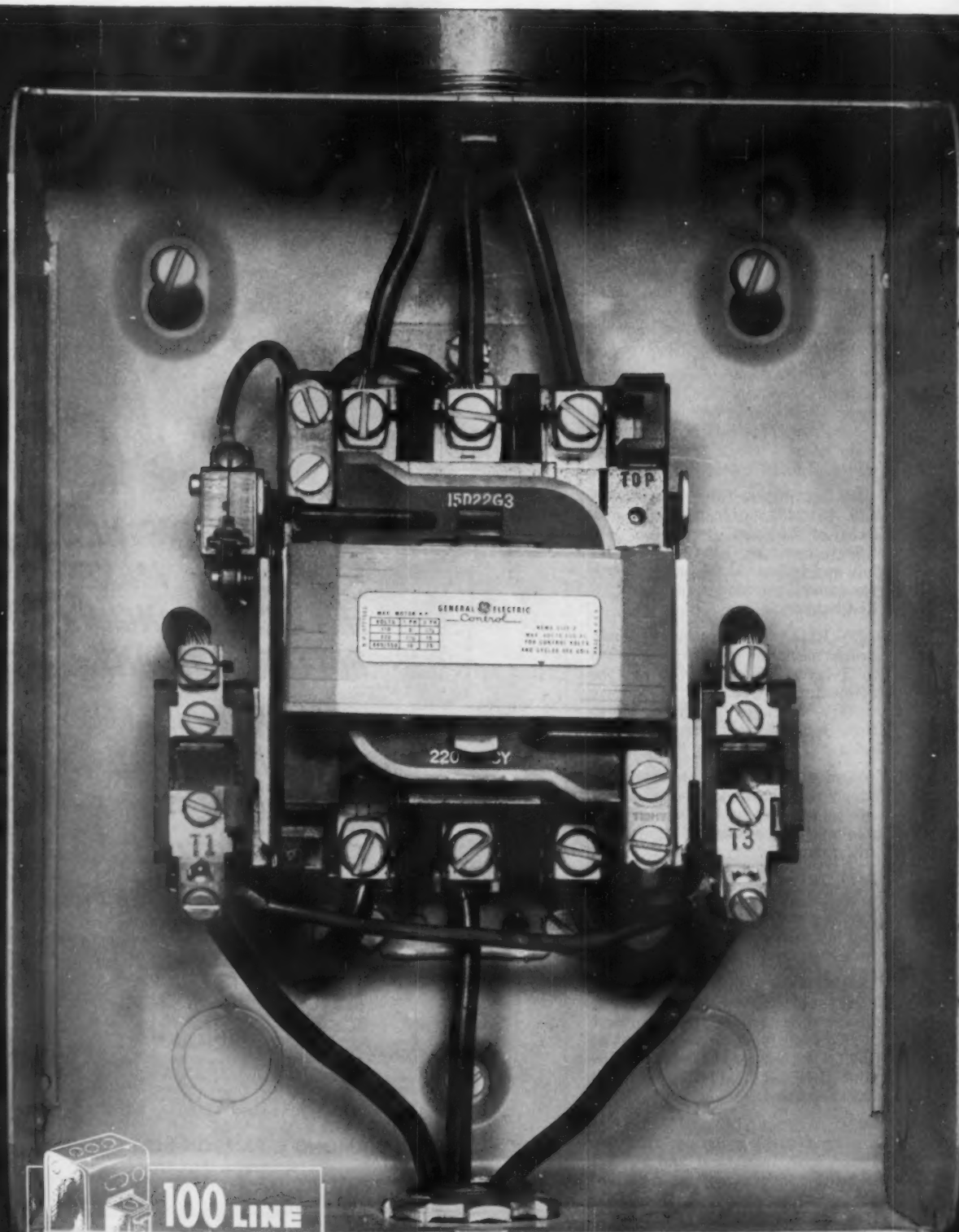
#### OTHER PRODUCTS

- DIAMOND Lag Screw Expansion Shields
- KEYSTONE Machine Bolt Expansion Shields
- "DI-EN-KEY" Closed Back Machine Bolt Expansion Shields
- "N" Star Type Masonry Drills
- MULTI-SIZE Wood Screw Anchors
- SUPER-GRIP Stud Type Expansion Anchors
- D H D Hammer Drive Anchors (Nail Type)
- DI-FORGE Percussion Type Masonry Drills
- DI-STAMPT Pipe Clamps
- RAM Heavy Duty Lead-Iron Anchors
- DIAMOND-P Lag Screw Expansion Shields
- DIAMIDE Carbide Tipped Masonry Drills
- WING-DING Wall Screw Anchors.



**DIAMOND EXPANSION BOLT CO., INC.**  
Garwood, New Jersey

14% SMALLER, 10% MORE WIRING ROOM—



# THE RADICALLY NEW GENERAL ELECTRIC SIZE 2 MAGNETIC STARTERS ARE...

# EASY TO INSTALL

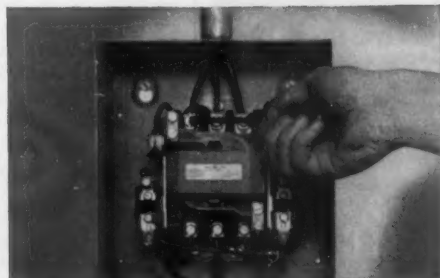
Radically new and specifically designed for easy installation . . . General Electric's 100-Line Size 2 magnetic starter can significantly reduce your costs by saving both installation time and money. You save with these features:

**STRAIGHT-THROUGH WIRING**—With G.E.'s new Size 2 starter, all line terminals are at the top and all load terminals are at the bottom. Straight-through wiring and new pressure-type terminals save you time because no wires need be bent or looped. You can do all wiring from the front—where it's easy to see, easy to reach.

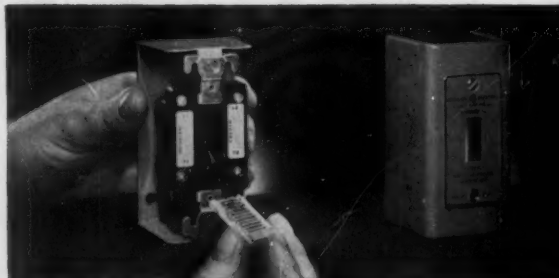
**10% MORE WIRING ROOM**—Even though the Size 2 starter features a 14% size reduction, you still get more actual wiring room—about 10% more than with former starter models. Additionally, you get even more accessibility because of the wrap-around cover. All you need do to remove the enclosure cover is press the spring-clip latch.

**CALL YOUR NEARBY G-E Apparatus Distributor** or write Section 733-47, General Electric Co., Schenectady, N. Y. (Ask for GEA-6611.)

GENERAL  ELECTRIC



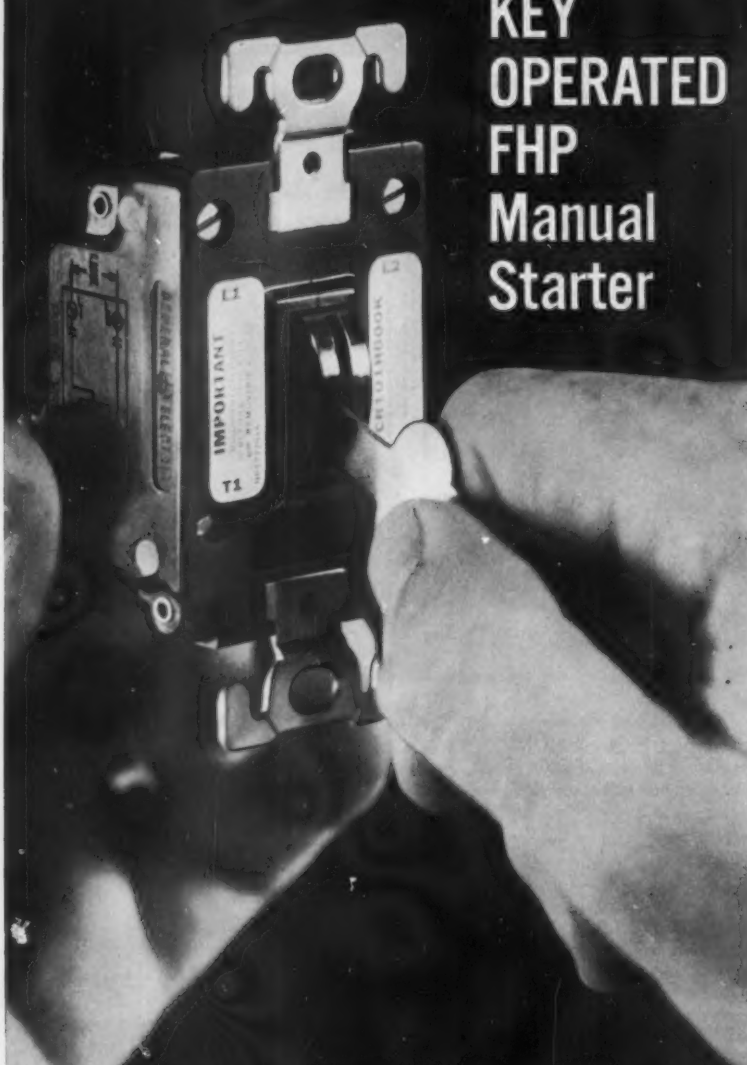
**EASIER WIRING** is possible because of 10% more wiring space in the enclosure and easily removed wrap-around enclosure cover.



**NEW FHP MANUAL STARTER**, which is now available in key-operated forms, features an exclusive plug-in heater. (Ask for GEA-6358.)

# New General Electric . . .

## KEY OPERATED FHP Manual Starter



For schools, hospitals, offices and other applications where you must protect against unauthorized operation, General Electric's new fhp key-operated manual starter is the answer. A key is required for ON-OFF operation. Starter features plug-in heater, straight-through wiring for easier, faster installation. Enclosures and flush plates are also available in kit form. Write for bulletins GEA-6358 and GEA-6976. General Electric Company, Schenectady, N. Y. 733-49

**GENERAL  ELECTRIC**

(70) **MAGNETIC STARTERS.** Cat. 14-B1, 16 pages, introduces redesigned line through 15 hp, 440-550 volts. Furnas Electric Co.

(71) **SWITCHBOARDS.** Bulletin 2015, 6 pages, covers three types of shallow-depth boards: incoming line sections, distribution sections, and combined metering and distribution sections. Federal Pacific Electric Co.

(72) **TRANSFORMERS.** Cat. 5A3 describes redesigned line of boost and buck transformers with connection taps to increase line voltage in five steps from 6.66 to 26.64% or reduce line voltage in five steps from 4.75 to 11.8%. Acme Electric Corp.

(73) **PANEL SWITCHES.** Bulletin 55 describes Twinlite series of lighted pushbutton switches for computers, office machinery, machine tool control and instrument panels. Electrosnap Corp.

(74) **VOLTAGE REGULATORS.** Bulletin S2591ET, 8 pages, covers Stabiline instantaneous electronic transistorized units for automatic equipment voltage regulators. Superior Electric Co.

(75) **MOTORS AND GENERATORS.** 6-page bulletin describes squirrel-cage, special purpose wound rotor and dc motors from 1 to 200 hp plus generators and m-g sets from 1/2 to 150 kw. Imperial Electric Co.

(76) **MARINE EQUIPMENT.** 8-page brochure describes latest developments in marine generating and control equipment, including 10-, 15-, 25-, 35- and 50-kw response systems, high-capacity 125-volt dc systems and standard 5- and 7 1/2-kw response systems. Safety Electrical Corp.

(77) **MOTOR MAINTENANCE.** Authoritative 63-page booklet, "Protective Maintenance of Motors and Generators"—intended primarily for use of electrical maintenance men. NEMA.

(78) **GIMBAL RINGS** for PAR 38, 46, 56 and 64 side-prong lamps and R-30, R-40 and Par 38 screw-base lamps. Bulletin includes charts and diagrams showing application to fluorescent fixtures. Alexander-Tagg Industries Inc.

(79) **TRANSFORMER INSULATION.** Booklet outlines process for insulating transformer with Scotchcast epoxy resin. 8 pages. Minnesota Mining & Mfg. Co.

(80) **ENCAPSULATING MOTORS.** Two methods of encapsulating rewound motors in epoxy resin are presented in step-by-step procedure in 4-page brochure. Minnesota Mining & Mfg. Co.



## New Books & Pamphlets

**1959 National Electrical Code**, 528 pages, \$1.00. National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.

Complete revision of 1956 edition incorporates a substantial number of new safety provisions with extensive editorial revisions including placement of tables and diagrams, formerly in Chapter 10, in their appropriate spots in the text. A completely new system of numbering sections and paragraphs has been adopted; a cross-reference index provides handy identification of new numbers with old.

**Factors in Special Fire Risk Analysis** by William Durant Milne. 165 pages, \$10.00. Chilton Co., Book Div., 56th and Chestnut Sts., Philadelphia 39, Pa.

An analysis of the interrelationship between field inspector reports and examining underwriters; a discussion of the obligations of insurance companies, the occupancy hazards of buildings, construction problems, and fire protection.

**Soldering Manual**. 176 pages, \$5.00. American Welding Society, 33 W. 39th St., New York 18, N. Y.

Twenty-one chapters deal with principles of soldering, solders, fluxes, joint design, surface preparation, processes and procedures, inspection and testing, metals and alloys, and printed circuits. Equally useful to both amateur and professional, the manual supplements its text with 81 illustrations and 34 tables.

**Farm Electric Sales Handbook**. 66 pages; \$3.50 plus postage. Edison Electric Institute, Sales Div., 750 Third Ave., New York 17, N. Y.

Subjects covered include sprinkler irrigation systems, underfloor heating cable, electric dairy equipment, electric brooding, egg cooling and storage, and others. Principal advantages of each are outlined, including such information as size of equipment needed for the various uses, capacities, operating costs, installation costs, initial investment costs, and average kwhr use. Loose-leaf, 4½ by 7½ ins.

**Current Projects of the American Standards Association**, 52 pages, 75 cents to members; \$1.50 to non-members. ASA, Dept. PR94, 70 E. 45th St., New York 17, N. Y.

Answers questions concerning standardization activities in the electrical industry, describing

# PROVE IT FOR YOURSELF!

## 6063-T6 and 6061-T6

### Aluminum Alloys

## Make Husky Cable Support Systems Twice as Strong!

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scope of each project in 19 standard categories, together with an index and list of sponsors.

**NEMA Standards** available from the National Electric Mfrs. Assn., 155 East 44th St., New York 17, N. Y.:

**Industrial Control**, IC 1-1959, \$6.00.  
**Large Generating and Converting Apparatus**, LG 2-1959, 30 cents.

**Pressure Connectors for Copper Conductors**, SG 8.1-1959 and SG 8.2-1959, 30 cents each.

**Gas Turbine Power Plants**, SM 30-1959, \$1.00.

**Returnable Reel Dimensions for Wire and Cables**, WC 20-1959, 25 cents.

**Symbols for Metering Diagrams**, Publication No. 59-71, 15 pages, 60 cents. Association of Edison Illuminating Companies, 40 W. 40th St., New York, N. Y.

Report covers symbols suggested for use in one-line metering diagrams, circuit wiring diagrams, and construction diagrams. Sample drawings give examples of their use.

**Building Exits Code**, NFPA No. 101, 256 pages, \$1.50. National Fire Protection Assn., 60 Batterymarch St., Boston 10, Mass.

New 1959 edition includes many new features of life safety from fire. It deals not only with exits but many related features such as exit lighting, signs and similar subjects.

**Arc Welding Training Manual**, \$3.00. American Welding Society, 33 W. 39th St., New York 18, N. Y.

Contents include welding processes and recommended safety practices, the metal-arc process, accessories, exercises in arc welding, arc welding equipment, identification of metals, and metals and their structure. 337 line drawings, half-tones and tables are included.

**Guide to Incandescent and Fluorescent Lamps for Commercial Applications**. Westinghouse Electric Corp., Bloomfield, N. J. 5 cents.

A helpful guide to the proper use of incandescent and fluorescent lamps. Guide lists various commercial establishments such as supermarkets, clothing stores, drug and variety stores, beauty and barber shops, restaurants, schools and offices, giving lighting applications commonly found in such establishments, suggests specific lamps to use, and indicates effect to be expected from each.



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	CAROL	A	B	C
Electrical Insulation Resistance (1)	100	17	16	68
Cold Bend °F (2)	-50	-45	-90	-50
Abrasion Resistance (1)	91	62	100	92
Ozone Resistance (1)	100	6	18	12

Note: (1) 100 indicates best—others % of best (2) cold bend—actual test temperature

Note how, in Brands A, B and C, there is a marked lack of balance between abrasion resistance and ozone resistance. This means that these cables can crack long before they wear out. Also, it is quickly apparent that needlessly high cold flexibility may be built into a cable...but at the sacrifice of more important electrical properties.

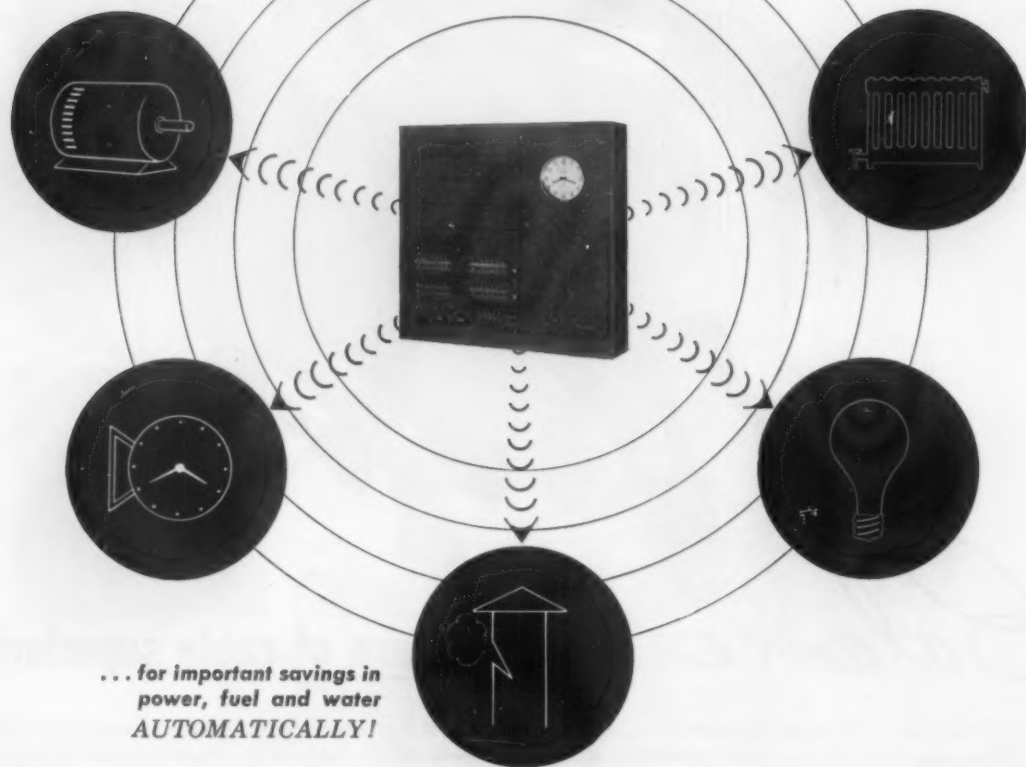
But Carol cable, in addition to having the highest combined rating, is also the best balanced... with primary emphasis on the characteristics most vital to cable life and performance. The balance built into Carol cables is your assurance of superior quality throughout...extra quality and performance where it is most needed.

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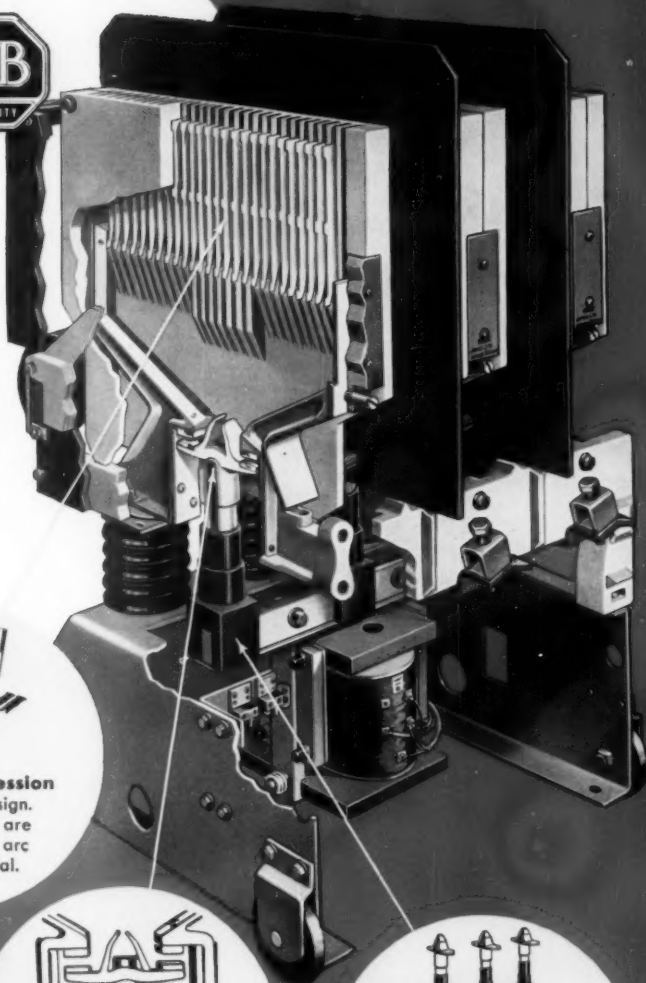
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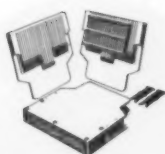


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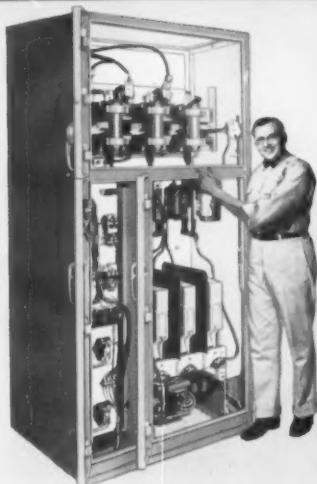
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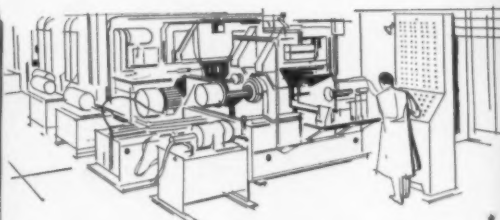
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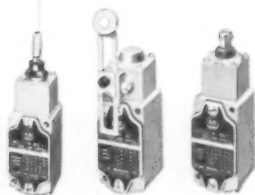
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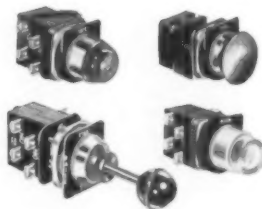
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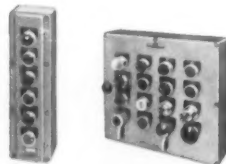
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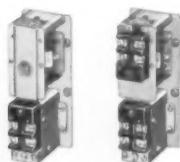
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# Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay \$5.00.

## Gas Generators for Lighting Loads

**QUESTION P36**—Have had two inquiries about a system of gas lighting which was used some years ago. This system used lump carbide and water, the water being fed as needed to the carbide where the gas was generated as fast as the load required, evidently with a pressure switch operated by the gas to open or close the water flow. Would like to have any information from other readers who may have worked on some of these generators.—E.E.M.

**ANSWER TO P36**—Regarding acetylene gas generators, most of these machines fed the carbide, as needed, into a large body of water. As gas was generated it raised a water sealed bell, similar in principle to the large city gas holders; this stopped the carbide feed. When the bell settled down as gas was used, more carbide was fed into the water, repeating the cycle. The gas pressure had nothing to do with the feed in these low-pressure house installations; it was governed and held constant by the weight of the bell, and only the volume of gas in it, whether full or empty, controlled the carbide feed.

Dripping water on a mass of carbide also produces gas, but with a great amount of heat which tends to break down the gas; this system was only used in small automobile generators before the days of the Prestolite tank, and in miners' lamps, where the light weight and small size were important. I also believe some acetylene generators designed for welding at 15 psi pressure, are pressure controlled, but these are outside the above question.—W.W.W.

**ANSWER TO P36**—For a period of six years I worked out of a repair shop where the National Carbide Co. had installed several farm gas lighting plants similar to the one E.E.M. describes.

These plants were all heavy gauge galvanized iron, consisting of a tank 4 ft dia, 8 ft deep; then a floating tank inside, holding 200 lbs of  $\frac{1}{4}$  by  $\frac{1}{2}$  in. carbide.

To charge the system, first you

filled the 4- by 8-ft tank with water, 4 ft deep. Then you put in the carbide in the portable floating top part. This fit into a rubber seal, and when you put it into the 4- by 8-ft tank, a trap door opened, and released a small amount of gas. As the gas built up pressure between the floating inside drum and the water, it raised the float, and shut off the carbide.

I serviced several of the gas generators. They worked fine and gave off a nice white light. I would say they were comparable to 7½-cent kwhr electricity. Of course, the more lights you need, the more it cost you. Each light had a flint on a ratchet wheel. You just turned on a small valve; gave the flint a sharp turn, and the lamp lit. For an out of the way place they were very convenient.—J.P.

**ANSWER TO P36**—About 40 years ago I serviced one of the generators referred to, and to the best of my recollection, it was called "North Light," and was made in Buffalo, N. Y.

There was a compartment for the carbide, and means to remove the residue. In connection, there was a tank of water, the water being held to the proper level by a float valve.

Within this tank was another tank, open at the bottom end, into which the gas was piped when created. When the inner tank was in a low position, it automatically operated a means to allow water to flow to the carbide. As gas was created, it would raise the inner tank to a floating position, and keep on rising until the proper amount of gas was formed; then it automatically shut off the flow of water to the carbide.

Naturally, when servicing the generator, I did not smoke or allow a flame of any sort to be present. It was housed in a room built for the purpose.—B.A.S.

## Distorted Sine Wave

**QUESTION Q36**—Where the frequency is O.K., but the wave shape of each cycle is not a sine wave, how can the wave shape be made into a

sine wave to get better motor operation?—E.B.

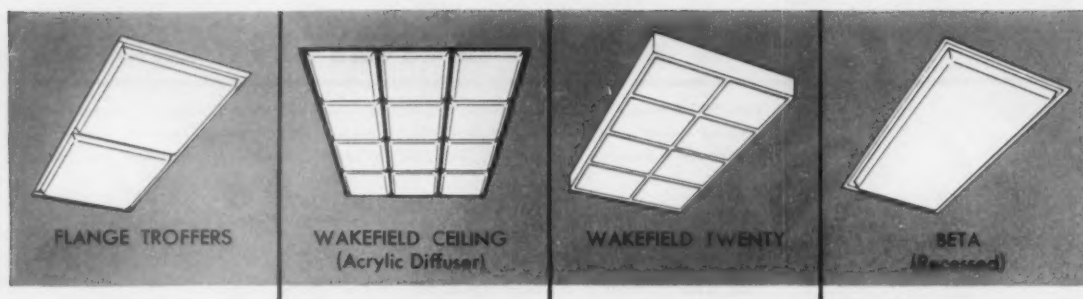
**ANSWER TO Q36**—By the nature of your question, it is safe to assume that you "create" this voltage, as no public utility supplies anything but a sine wave. Further, you are not utilizing a uniform field alternator, as that machine, by its very nature, produces a sine wave.

Therefore, your inverter is faulty, and the best recommendation is to change from your present system to a rotating machine. That is, of course, providing that your wave shape produces noise or loss of power in your motor. It is well to remember that a slight deviation from the sine wave normally will not affect the operation of the motors.—J.M.

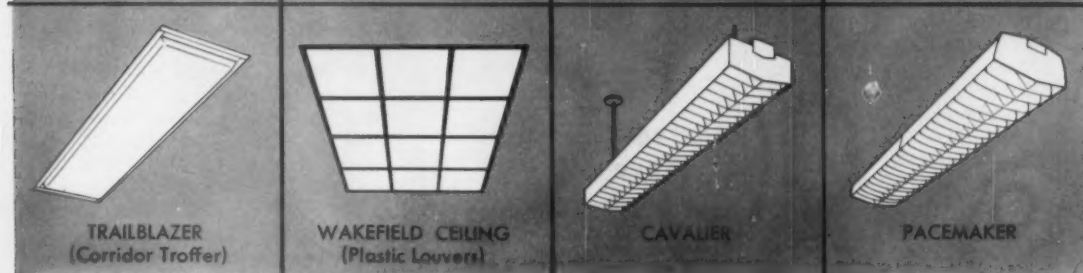
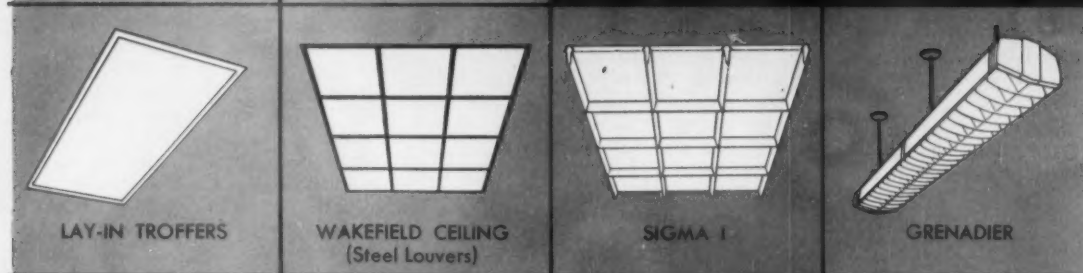
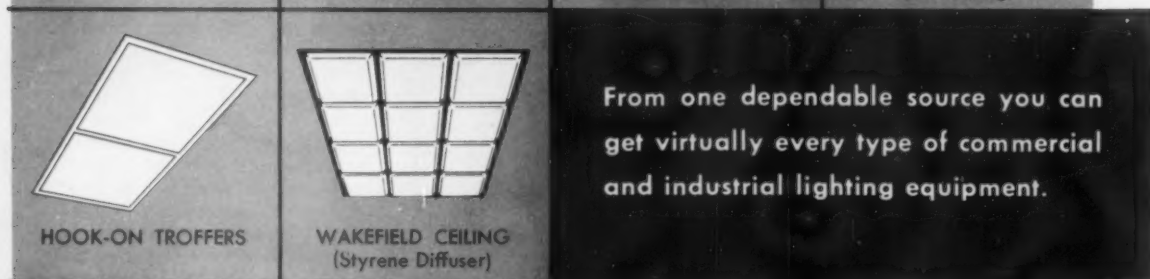
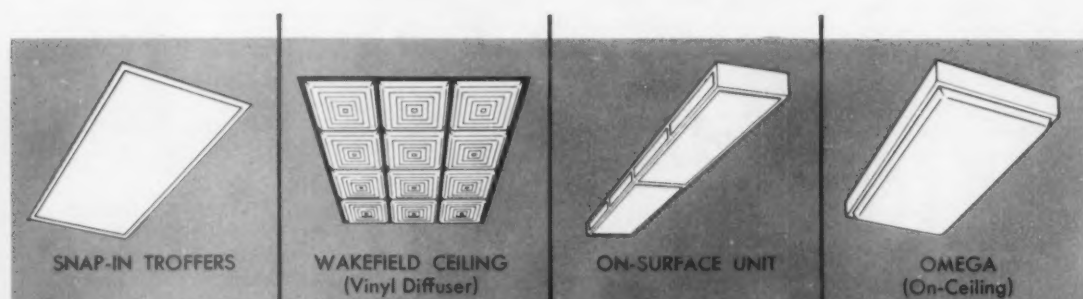
**ANSWER TO Q36**—A distorted ac wave can be resolved into a smooth 60-cycle fundamental sine wave plus superposed odd harmonic sine waves such as the third, fifth, seventh, etc. (Were there even harmonic or harmonics, predominates; ponent, which, obviously, is not possible with ac.) The first step, then, would be to find out which harmonic or harmonics, predominates; that is, are the worst offenders. There are various ways to do that (oscillogram analysis, harmonic analysator). Suppose the answer is the fifth or seventh (300 and 420 cycles). One can then construct a wave trap. In case of single phase, it consists of a reactor built into the line, and two tuned circuits across the line. The reactor carries full 60-cycle line current, and develops a tolerably small 60-cycle voltage drop. The two circuits, each consisting of a capacitor and reactor connected in series and tuned to 300 and 420 cycles respectively, effectively short-circuit the harmonic voltages so that the wave shape at the load is essentially sinusoidal.

In case of 3-phase power, three such wave traps are required to eliminate undesirable harmonic frequencies of the fundamental.

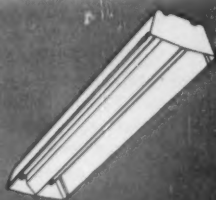
Obviously, this will be quite expensive. It is a sounder approach to find out what caused wave shape distortion to begin with, and to rectify the trouble at the source.—L.F.R.



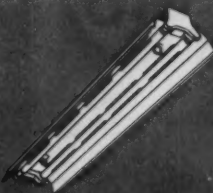
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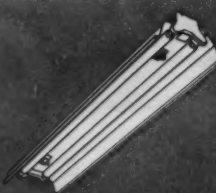




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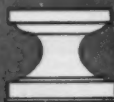
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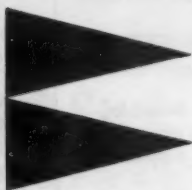


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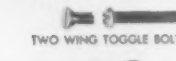
HOLD-IT EXPANSION SHIELD



DOUBLE EXPANSION SHIELD



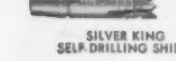
LAG SCREW EXPANSION SHIELD



TWO WING TOGGLE BOLT



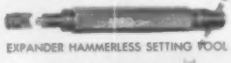
TUMBLE TYPE TOGGLE BOLT



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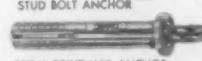
EXPANDER HAMMERLESS SETTING POOL



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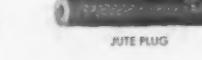
STUD BOLT ANCHOR



SPIRAL-DRIVE NAIL ANCHOR



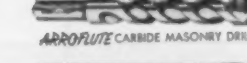
LEAD SCREW ANCHOR



JUTE PLUG



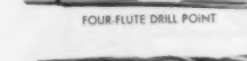
ARRO-CORE MASONRY DRILL



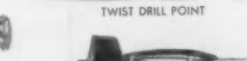
ARRO-FLUTE CARBIDE MASONRY DRILL



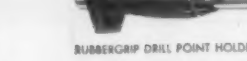
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## Direct Current Arcing

**QUESTION R36**—The haulage system of our mining operation consists of one 13-ton, 250-volt, dc trolley locomotive, remotely controlled from each ore chute by a P.B. station which operates a panel-mounted dc contactor, to energize and de-energize the trolley line as each car is spotted at the chute for loading.

This system necessitates leaving the locomotive controller about two-thirds on. This in turn creates a problem of severe arcing of contacts at the panel-mounted contactor.

Would it be practical to install standard power capacitors of say 25 kvar each in parallel across these contacts to reduce the severity of the arc? If so, approximately how many kvar of capacity would it require to attain effective results?

The contactor panel consists of two contactors connected in parallel. Would it be of any advantage to connect them in series?—A.A.N.

**ANSWER TO R36**—One large contactor would be better than two contactors, each of half the size in parallel. For two contactors, each of half the size in parallel, to divide the arc equally, both would have to open exactly at the same time, be exactly alike, and connected exactly alike. If you carefully watch the contactors in parallel, you will usually find that one contactor takes most of the arc.

The series arrangement would be better than the parallel during the opening period. During the closed period the contacts may be overloaded, overheat and corrode, unless contacts were rated for the entire current. Standard method is a blowout coil.

The present trend is towards using selenium rectifiers in place of capacitors, which are too bulky, and also cause a series of charges and discharges of decreasing values, unless used with a resistor.—E.B.

**ANSWER TO R36**—Addition of capacitors across the contactors feeding your locomotive trolley would be extremely hazardous. A failure in the capacitor (short-circuit) would start your locomotive, and you would not be able to stop it. It would be possible to avoid this difficulty by placing a fuse in series with the capacitor, sized to blow quickly on locomotive current.

Another alternative would be to install an additional contactor, which closes the capacitor circuit across the main contacts after the

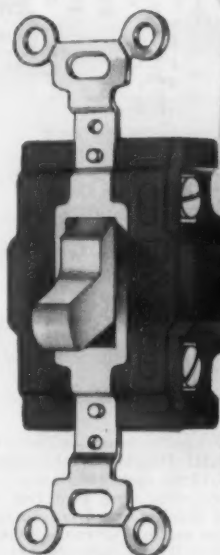
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\*Slogan for the new Canada House

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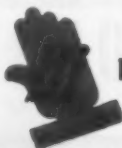
Cut installation and service costs on entrances of 200 amps. or more—eliminate costly, power consuming meter-loops with HI-LINER! Head and shoulders above the usual pole-top metering installation, the Hi-Liner combines an overhead mounted current transformer with ground controlled line switches in rain-tight steel cabinet. Installation is fast... all you need is one 4-conductor #12 cable and 1½" conduit running down the pole to the meter. No more heavy wire loop, weatherhead, large diameter conduit—and you'll eliminate the entire voltage drop of the meter loop! Now your customer can disconnect his entire system for emergencies or repairs—and you'll eliminate countless service calls on disconnects and local failures.

**NEW!** Two-way split entrance breaker—provides all the advantages of the Hi-Liner plus a split of the 200 amp. service into two 100 amp. lines. Breakers may be ground controlled either individually or simultaneously.

**NEW!** Underground secondary—contains a 200 amp. meter socket, 200 amp. circuit breakers with overcurrent protection, secondary wiring trough and terminal strip in one compact, pre-wired package!



**WRITE TODAY —** for detailed specifications on single phase, three phase, split-breaker, and other Hi-Liner units.



**HI PRODUCTS, INC.**

7740 Wentworth Ave., So.,  
Minneapolis, Minnesota

A SUBSIDIARY OF GENERAL ELECTRONIC CONTROL, INC.

main contacts close, and open the capacitor circuit after the main contacts open.

The operation of the contactor should be observed. Closing in on the heavy load may cause arcing and sputtering and possible welding, especially if the contacts bounce on closing. In this case the capacitor would discharge through the contacts when they close, adding to the locomotive current, and making matters worse. If an auxiliary contact on the capacitor were used as explained above, this objectionable situation would be avoided.

On the other hand, excessive arcing may occur if the contacts interrupt heavy currents, as when the locomotive is jogged for spotting. A capacitor may reduce this problem.

A capacitor "say 25 kvar" is rather meaningless. A 230-volt, 25 kvar ac, 60-cycle capacitor would be suitable for about 600 volts dc, and its capacitance would be 1230 mfd. A similar 25 kvar, 460-volt capacitor would be 307 mfd. Within reasonable limits, the arc suppression obtained when the contacts open would be proportional to the capacitance in microfarads. As a practical matter the thing to use would be 150 mfd, 300-volt, electrolytic capacitors, which cost about \$2.00 apiece at radio supply houses. These should be connected in multiple across the contacts, using enough units (by trial) to obtain the desired arc suppression, observing proper polarity, and providing an auxiliary contact. (If the capacitors are connected directly across the main contacts, they will charge up when the contacts are open, and discharge a heavy current, in the same direction as the load current, through the contacts when they close.)

The operation described imposes severe and unnecessary abuse on the locomotive motor and running gear. I would recommend connecting your two contactors in series, with a resistor across the No. 2 contactor. These contactors should be connected so No. 1 closes first, energizing the trolley through the resistor, and then applying full line voltage to the trolley when contactor No. 2 closes. To stop the locomotive, contactor No. 2 should be electrically interlocked to open first, and then No. 1. This is the desirable arrangement if your contactors are having trouble interrupting the load current.

The contactors may be connected in parallel, using a resistor in series with No. 1 contactor; none, or a smaller resistance in series with



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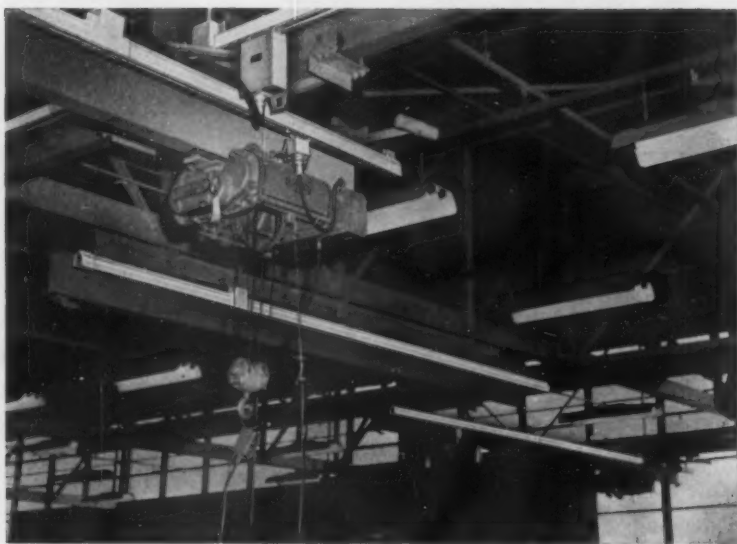
at no extra cost. Outer protecting jacket contains not less than 67.32% Neoprene and is so certified by a Registered Professional Engineer. When you buy Bronco 66 Certified, you get the most Neoprene for your money. Means maximum protection from oil, acids, alkalis, heat, cold, flame. Always specify Bronco 66 Certified and enjoy the long term economy of top quality.

Self-measuring jacket is branded every two feet by a patented Bronco process—U. S. Patent No. 2,667,001. Complete identification is molded into the jacket so it won't rub off. Butyl rubber insulation is built to exceed ASTM D-795 test requirements. Jacket and insulation are Synchro-Cured, the exclusive Bronco process of vulcanization, to work as an inseparable team.

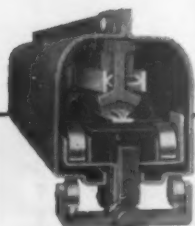
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No. 2 contactor. The contactors should be closed in sequence 1,2 and open in sequence 2,1. This is the desirable arrangement in case the contacts are eroding when they close.

In lieu of these "home made" arrangements, a better answer would be to replace the two contactors feeding the trolley line with a commercial magnetic step resistance controller, or better still, control the voltage of your dc generator by control of the field current, and eliminate the contactors. Any of these alternatives would reduce the contactor arcing, commutator sparking, and shock loads on the locomotive gearing, generator, and electric system.—R.L.M.

**ANSWER TO R36**—This is a perfect job for a 2- or 3-stage resistance, cutting out the magnetic controller that uses some kind of timer. This would help the commutator and brushes. The automatic controller can be on the locomotive or at the panel if the locomotive has one motor. A furnace type damper controller can change the drum controller to an automatic controller at very low cost.—H.S.

## Can You Answer These QUESTIONS?

**QUESTION B37**—In connecting ac meters on the switchboard, does it affect the accuracy of the meter to splice 4 or 5 ft of wire to the potential and current transformer secondary leads so as to make them reach the meters?—G.J.P.

**QUESTION C37**—The plant where I am employed is about to make a purchase of a battery-driven pulp handling equipment. It is planned to use storage batteries for this application.

Some engineers say it is best to use lead-acid batteries. Others say the Edison nickel-iron-alkaline storage battery is much better.

How does the purchase price, efficiency, ruggedness, maintenance, life, weight, size and time required to charge each type compare?—M.D.

**QUESTION D37**—What condition must be met for satisfactory operation of distribution transformers in parallel? What effect will the transformer constants have?—J.A.M.

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YOUR ANSWERS BY NOVEMBER 15**

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**Quartzzone**

TUBE

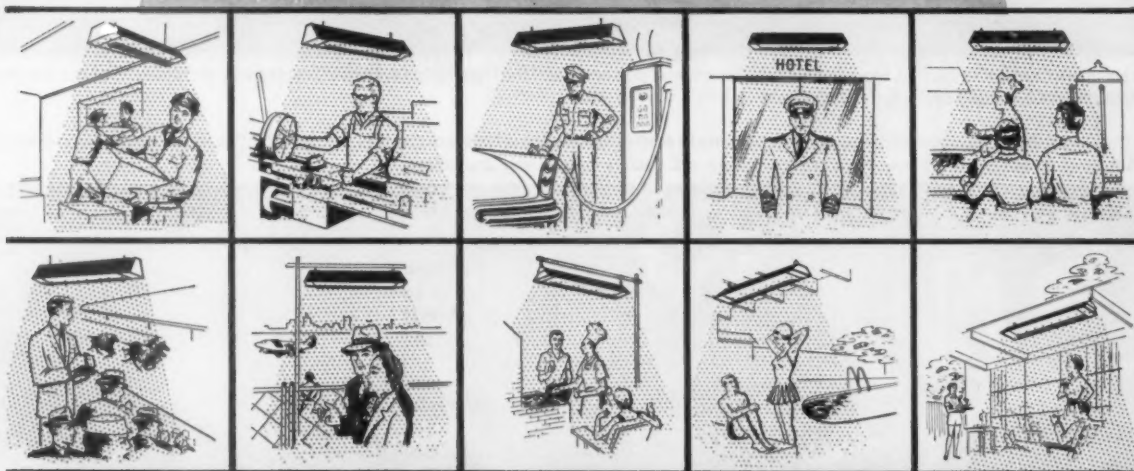
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**ELECTROMODE**

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■ Hallmark Cards, Kansas City, Mo., where Curtis Visioneers "personalized" the illumination system in keeping with the products of the company. Architect & Consulting Engineer: Welton Becket.

■ Curtis Vari-Spots produce attractive lighting patterns in several lobbies of the Hallmark Cards building. Reception room shown is approximately 45 ft. by 45 ft. Vari-Spots are used here to accent two areas. Each is impressively dramatized.





■ General office. Curtis Alzak aluminum low-brightness troffers assure glare-free illumination throughout the area, combining visual well-being with visual charm.



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**Hallmark Cards**

**say "Welcome!"**

*Special illumination effects in greeting card building . . .  
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It's only natural that a greeting card company would want to capture the spirit of its product in its headquarters building. And that was done at Hallmark Cards, Kansas City, Missouri. Technically, the lighting problem called for a system that would be uniform throughout the structure, yet provide the same glare-free illumination in rooms of various sizes. The assignment clearly prescribed Curtis Visioneering. The desired result was effected when Curtis designed a lighting system combining Curtis Alzak aluminum low-brightness troffers and Curtis Vari-Spot recessed incandescent units. The careful application of Curtis products completed the theme of visual charm and warm greeting, thus accentuating the aesthetic characteristics of the Hallmark Cards building. For assistance on your lighting problems write for the name of the Curtis Visioneer nearest you. Curtis-AllBrite Lighting, Inc., 6135 W. 65th Street, Chicago—352 Shaw Road, South San Francisco.



**CURTIS**

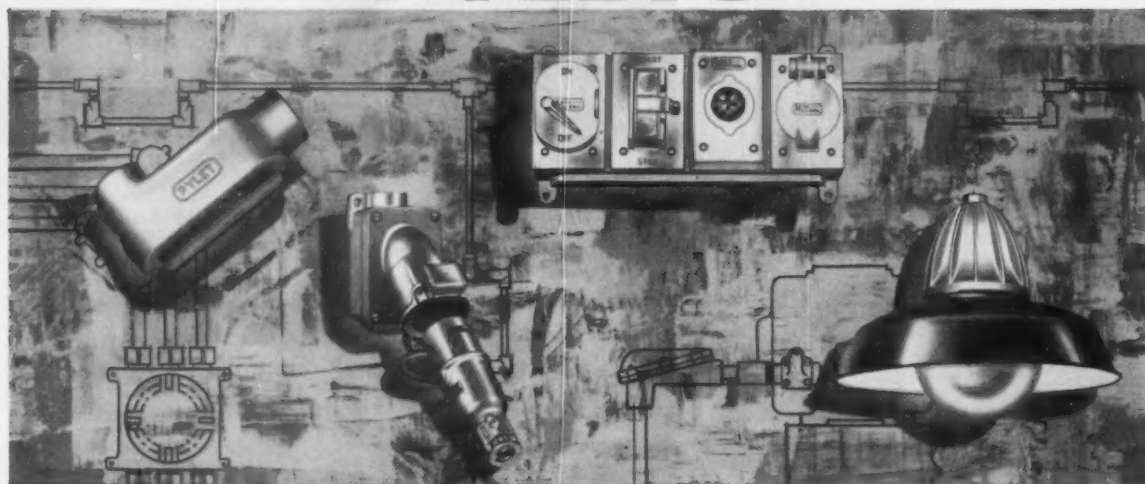
visioneers in planned lighting



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# Questions on the Code

Answered by:

**B. A. McDONALD**, New York Board of Fire Underwriters, Rochester, N. Y.

**B. Z. SEGALL**, Consulting Electrical Engineer, New Orleans, La.

**R. E. WARD**, Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.

## Grounding

**Q.** In our city the Power Company requires that the bare neutral be run through the meter without being broken, into a hole through the meter base to ground. They say it saves meters and better protects against lightning. What do you think?—H.R.

**A.** Questions such as these are best answered by those familiar with local conditions. In general, it may be stated that these bonding and grounding problems are worked out to comply entirely with the spirit of the code requirements. Specifically, practical application of the grounding requirements may have to be applied in a manner seemingly at variance with the spirit and intent of the code requirements. However, after a detailed discussion and analysis of all factors involved, it will be found that adequate protection has been provided, no hazard has been introduced and the code requirements have been complied with.

The code represents the best compromise available for the overall situations to be met throughout the country. In its attempt to represent all facets of the industry it may step on some pet procedure of operation in a specific locale, and at such times this situation should be met with the same sense of compromise in working out a specific solution. All interested parties should be heard and the best compromise should be evolved to fit the particular situation at hand.—B.Z.S.—10/59/1

## Cellulose Fiberboard

**Q.** How may one determine if the ceiling is combustible, low-density cellulose fiberboard as is mentioned under Section 4184, National Electrical Code?—S.L.

**A.** The 1959 National Electrical Code clarifies the question raised as there has been much controversy over the definition of this type ceiling. Section 410-74 of the 1959 Code states in a fine print note as follows:

"Combustible low-density cellulose fiberboard is considered to include sheets, panels and tiles which have a density of 20 lbs per cubic foot or less, and which are formed of bonded plant fiber material; but does not include solid or laminated wood, nor fiberboard which has a density in excess of 20 lbs per cubic foot."—R.E.W.—10/59/2

## Service Entrance Cable

**Q.** The suggestion has been made to the Board that we prohibit the use of service entrance cable for use as service risers. We know this would be in excess of NEC requirements, and would like to consider the problem on the basis of being in the interest of added safety for the customer. Your comments pro and con will be helpful. Section 3382 limits the use of SE cables with bare neutral. We would appreciate the reasoning behind this rule.—C.R.A.

**A.** Section 2331 of the code recognizes the use of cables approved for the purpose to be used as service conductors extending along the exterior, or entering buildings. There are no specifications in the code covering their construction, and while the inspector has the responsibility for determining the phrase "approved for the purpose," service cables listed by Underwriters' Laboratories, Inc. are generally accepted as satisfying this phrase as used in this section of the code. Section 2303 of the code recognizes a grounded service conductor without any insulation provided the voltage to ground does not exceed 300 volts. This rule applies to both raceways and service cables. In the case of service cables, the grounded conductor is covered by a tape and a braid which provides some insulation, but not equivalent to that required by the code for a fully insulated conductor.

Section 2332 of the code requires "service entrance cables, if liable to contact with awnings, shutters, swinging signs, installed in exposed

places in driveways, near coal chutes or otherwise exposed to mechanical injury, shall be of the protected type or be protected by conduit, electrical metallic tubing or other approved means." This code rule recognizes a distinction between conduit, tubing and service cable on the basis of mechanical injury.

Underwriters' Laboratories lists the following types of service entrance cable:

Type SE—Cable for above ground installation. This is the unprotected type of cable since it does not have inherent protection against mechanical injury.

Type ASE—Cable for above ground installation. This is considered to be a protected type cable since it does have inherent protection from mechanical abuse. This type of cable is rarely used, since the great majority of service entrance cables used over a period of many years are Type SE.

Type USE—This cable is for underground use and is not concerned with the question raised.

On the basis of N. E. Code rules, there is a distinction between metal rigid conduit used to enclose service entrance conductors and service cables which may be realized when we consider the following facts:

Rigid metal conduit is recognized by the code for all conditions of use, and is required to be used in many of our hazardous locations. There are no restrictions with respect to voltage, and it provides the enclosed conductors maximum protection from mechanical injury. As a raceway, conductors may be removed and replaced as the occasion may arise. It provides a low impedance path in a grounded circuit which facilitates the operation of overcurrent devices. It may be used in all types of occupancies, and as the "grand-daddy" of all our raceway systems of wiring it has proven, over many years of field experience, to be the safest method of wiring recognized by the code.

Service entrance cable with an uninsulated grounded conductor was first recognized by the code about 26 years ago. As the name implies, it was designed primarily

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# NEW "UNIVERSAL" PREHEAT-RAPID START LAMP



## 3200 LUMENS (cool white)

**In the highest-rated 40-watt lamp**

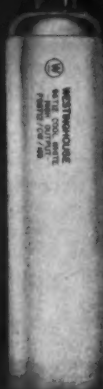
Get 21% more light using your present rapid start fixtures . . . 3310 lumens in white and warm white! The new "Crestline" is the only fluorescent with no "lazy ends"—even the bases let light through (optional at slight extra cost). Life rated at 7500 hours at 3 hours per start.



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Light output improved 23% over present H.O. type (High Output) lamps to make this the most economical 96" H.O. type lamp ever developed for application where high output lamps are used . . . 9300 lumens in white and warm white. This brightest of all 96" H.O. type fluorescents is rated at 7500 hours' life—more than 2 years' use in the average installation—and they're designed to operate on present 96" H.O. ballasts.



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job that two different types have been doing!

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(COOL WHITE)

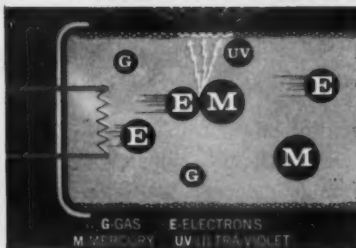
**Simplify stocking, ordering and maintenance** by specifying this one 40-watt fluorescent lamp for the job that two different types have been doing! The new Westinghouse "Universal" lamp can be used on either your present rapid start or preheat circuits with no loss in lumen output. You'll save storage space; save time and error in maintenance by stocking this one lamp.

Whether you're planning or expanding, you can use this lamp in your new fixtures, as well as in your existing ones. And here's the best news of all: light output has been increased to 2800 lumens, while the list price has been reduced to only \$1.25—5¢ less than old style rapid start lamps!

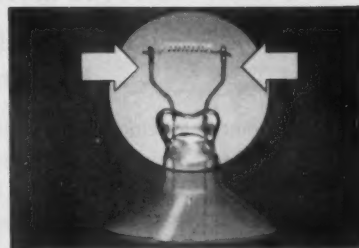
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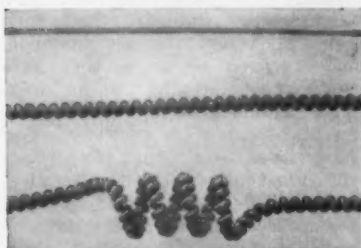
**Ultralume™ Phosphors:** Westinghouse research has proved that the size of the individual phosphor particles which coat the inside of a fluorescent lamp have a direct effect on the amount of light given off. Now, a new and exclusive Westinghouse process selects the right particle size for more efficient light-producing phosphors.



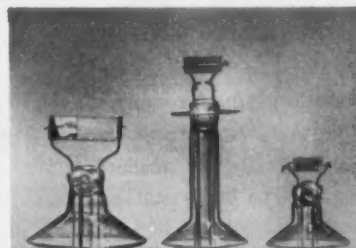
**Mixed Gases:** All fluorescent lamps contain mercury and gases. The gases serve as conductors until the mercury is vaporized. These gases and mercury vapor then convert electricity into ultra-violet radiation, which causes the phosphors to "fluoresce." Westinghouse uses the right mixture and pressure for each type of fluorescent lamp.



**Plated Leads:** The electron bombardment inside a fluorescent tube eventually causes particles of the metal supports and leads to sputter off causing "end blackening." To prevent this, Westinghouse plates the lead wires with super-hard chrome-vanadium. Result: tubes that stay brighter, end to end.



**Triple Coiled Electrodes:** Westinghouse uses triple wound electrode coils to hold the right amount of emission material. This carefully measured amount is heated quickly and adequately protected from bombardment to insure long life and trouble-free starting.



**"Custom" Anodes:** Anodes act as buffers and prevent excessive "sputtering" of emission material from the electrodes. Since the electrical characteristics are different for each type of fluorescent lamp, Westinghouse anodes are especially engineered to fit the electrical requirements of each type of lamp.



**Silicone "Raincoats":** In high-humidity areas, moisture can collect on the exterior surface of the lamp and prevent it from starting. To protect against moisture accumulation, Westinghouse fluorescents are given a special Silicone coating, or "raincoat," which disperses this film into harmless droplets.



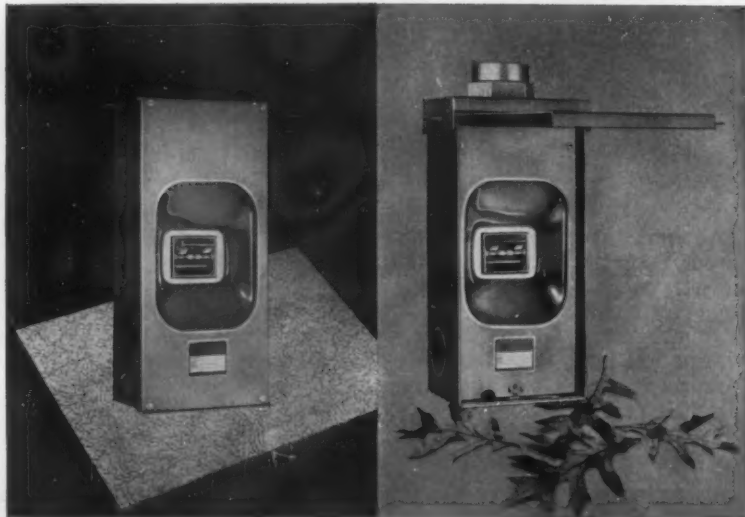
CONTACT YOUR LOCAL WESTINGHOUSE LAMP AGENT, OR WESTINGHOUSE LAMP DIVISION, BLOOMFIELD, N. J.

These new fluorescent advances are made possible by the same Westinghouse Research which brought you . . .

NEW SHAPE . . . NEW LIGHT . . . WESTINGHOUSE EYE SAVING WHITE BULBS . . . Another reason why—

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### 200 AMP SERVICE ENTRANCE EQUIPMENT

... small box  
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Customers looking for more electrical power will find a lot to like in this unit. Capacity is a full 200 amperes. "Full" because the Heinemann hydraulic-magnetic breaker makes de-rating as obsolete as yesterday's weather forecast. You can put this equipment next to heat lines, or let it sizzle in the summer sun. It always carries full rated current, always trips as specified. No thermal elements . . . no temperature-caused nuisance tripping.

Installation? Painless. There's enough space inside for two hands and wire. Solderless screw-type connectors save time and trouble. Knockouts are plentiful, placed so conduit can be run-in from any angle.

Cost? A little less than you are used to paying for equipment that supplies equal capacity *after de-rating*.

The size is another pleasant surprise . . . slightly smaller than fused pull-outs of the same rating. The equipment is rated at 120/240V AC, two- or three-wire service, and is available in indoor or raintight, tamperproof outdoor enclosures of heavy-gauge steel.

MORE QUESTIONS? SEND FOR BULLETIN 1003



# HEINEMANN

ELECTRIC COMPANY

132 Plum Street, Trenton, N. J.

*Circuit breakers*

S.A. 2046

to be used for services. Its use as a wiring method as now covered by Article 338 was first recognized in the 1935 edition of the code. At the present time, service entrance cables without individual insulation on the grounded conductor are recognized by Code Section 3382 as suitable for services; range, clothes dryer and domestic water-heater circuits; or as feeders from a service cabinet to supply other buildings, or as service entrance conductors for such other buildings, provided the limitations imposed by the code are satisfied. When all of the conductors are insulated however, it may be used for interior wiring provided the nature of the occupancy, and the conditions of use are recognized by the code. Type SE cable, when used for interior wiring, must be installed in accordance with the applicable provisions of Article 336 covering Non-Metallic Sheathed Cable. As a result, it could not be installed in any hazardous location, a commercial garage, a theatre or any other occupancy covered by Section 3362-c of the code. It also is vulnerable to mechanical injury and must be protected as covered by Sections 3364 through 3367 of the code. As a cable assembly, the conductors may not be removed or replaced.

It appears evident from the foregoing that the code makes a distinction, on the basis of hazard, between conduit and service entrance cable. There is no question however with respect to code recognition of SE cable for services, and field experience over the past 25 years, particularly with residential occupancies, indicate that such services, when properly installed, have proven to be a very safe method of serving a building. There is one advantage that service cable has over a raceway. You have the assurance that the conductors are continuous without splice, between the service head and the service equipment. In the days of residential conduit services, some electricians would not hesitate to splice wires in a service conduit, or even splice smaller conductors than required within the conduit enclosure. Such defects were difficult for an inspector to observe, and in many instances they only came to light when lightning or line surges caused a ground fault at the splice, and the resultant arcing caused fire. Such procedure is in violation of code rules, and is mentioned merely to show that any wiring method recognized by the code

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Always fresh, exceeding all ASTM electrical specifications. Slipknot has been the standard of the industry for more than half a century. Extra adhesive strength assures best work, even on rough and irregular surfaces. Non-raveling, never dries out . . . results of rigid quality control and tremendous volume.

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Inseparable fusion of adhesive to vinyl base means easier, swifter, surer, more permanent splicing than ever before! Slipknot Plastic Tape has wider temperature working range — no creeping or thinning — abrasion resistance — resists water acids, alkalies, oils, corrosion. Molds totally around any shape. No. 7 (.007" thick) has minimum dielectric strength of 10,000 volts.

The 66-foot roll, in individual can, comes with **FREE** exclusive Slipknot Cutter. (patented)



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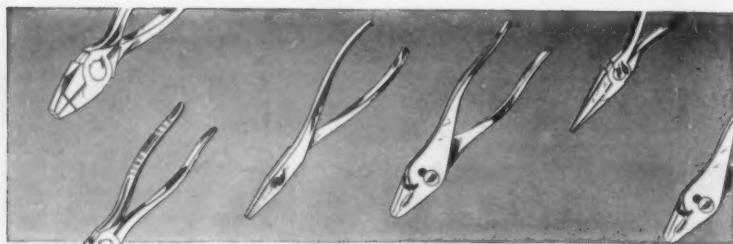
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ELECTRICAL CONSTRUCTION AND MAINTENANCE . . . OCTOBER, 1959

215



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reach for...



Skilled mechanics . . . thousands of them every year . . . reach for and buy Channellock pliers. Why? Ask them. They'll tell you they like the positive gripping power... the rugged strength... the precision balance... the all 'round handy "feel" of these quality pliers. And you will, too!

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**ASK YOUR TOOL SUPPLIER**  
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**JOHN S. GROBEN** and William C. Walker of the Althoff Howard Electric Co., Inc. in Evansville, Ind., take time out from their many administrative and engineering duties to pose for our reporter's camera during his recent "field trip" to their city.

may become hazardous when all of the rules are not observed.

Section 3382 recognizes the use of SE cable with an uninsulated grounded conductor for service use and other limited uses as covered above, when the voltage to ground of the ac supply does not exceed 150 volts. The question of using a bare neutral grounded circuit conductor with cable assemblies and conduit installations was thoroughly reviewed by a special committee during the period from 1930 to 1935. During this period a definite proposal for a revision of the 1933 code was presented for consideration. This proposal, which would recognize the general use of a bare neutral with the various wiring methods recognized at that time, was rejected. One of the principal objections was registered by the American Water Works Association who were concerned with the stray current effect on their water piping systems. Other objections concerned reversal of polarity which would energize the grounded conductor, and open circuits in the grounded conductor which also would present a hazard. In support of the proposal, field experience with bare neutral services as far back as 1909 was presented. The favorable field experience with range circuits wired with S. E. cable containing a bare neutral was cited. Trial projects involving the use of AEIC concentric cable also was presented in support of the proposal, and several buildings wired with rigid conduit or EMT with bare neutral throughout the installation were called to the attention of the committee.

The many details involved with





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*He thinks that his company's illumination is good.*

*You know different.*

*How do you convince him?*

*Silvray has found the way.*

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*Send me complete information on your new plan to help us sell the re-lighting market.*

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**LIGHTING**  
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## Cable News from

# A NEW INSULATION AND A

### NEW GE NO. 1799 DG VARNISHED DACRON GLASS PROVIDES MAJOR INSULATION IMPROVEMENTS

The new GE No. 1799 DG varnished Dacron glass insulation offers these major improvement values in varnished cloth-insulated cables:

#### Longer Life

- Lower electrical losses
- Better heat and moisture resistance

#### Ease of Handling

- Smaller over-all diameter

#### Reduced Insulation Thickness

- Greater dielectric strength
- Greater mechanical strength

#### Greater Current-carrying Capacities

- 0 to 15 kv—85 C conductor temperature
- 23 kv—80 C conductor temperature

#### Excels in test comparisons

Test comparisons between varnished Dacron glass insulation and varnished cotton are shown in the table at right. Of particular importance to cable users are those results which show that GE No. 1799 DG varnished Dacron glass insulation:

- ... has almost 20% greater dielectric strength than varnished cotton in a dry condition, much greater dielectric strength in extreme humidity.
- ... changes dielectric strength relatively little when stretched and when ambient temperatures vary widely.
- ... has stable power factor at much lower values than varnished cotton.
- ... will not tear lengthwise, and has

#### Physical and Electrical Properties of Tapes

Typical Values	GE No. 1799	
	DG	VC
Tear Strength — Grams		
Lengthwise	Does not tear	208
Crosswise	708	270
Dielectric Strength — Volts Per Mil		
IPCEA Method—Room Temp	1420	1220†
(step by step) 85 C	1200	1065*
Short Time Method—Dry —	1974	1574
96 hours in 96% humidity	1386	740
6% Elongation	1812	1200
12% Elongation	1755	700
Per Cent Power Factor		
Temp 30 C	2.3	6.9
Temp 80 C	3.5	9.2
Temp 100 C	6.7	13.4
Per Cent Moisture Absorption 96 hours at 96% humidity	0.64	1.9
Per Cent Water Absorption 96 hours in water 25 C	0.82	5.7
*Industry standard—1000 v/mil		
†Industry standard—750 v/mil		

almost three times as much crosswise tear resistance as varnished cotton.

#### Complete cables tested

Load cycle over-voltage aging tests were carried out to indicate in-service reliability of the new insulation. Cables insulated with GE No. 1799 DG varnished Dacron glass, rated 15 kv, were subjected to voltages of 150% and 175% of the rated voltage. The cables were cycled simultaneously from room temperature to 90 C and from room temperature to 100 C.

Extensive tests of this nature on finished cables and in field service installations confirm the excellent improvement values offered to cable users by this new General Electric insulation.

### Tape properties are greatly improved by G-E fabrication methods

Use of glass and Dacron, plus complete impregnation of the fabric with varnish, are primary reasons why G.E.'s new insulation offers longer life, easier handling, reduced insulation thickness, and greater current-carrying capacities, plus increased resistance to heat, corona, and moisture.

#### New pressure process

The base cloth consists of a woven fabric utilizing Dacron fibers and glass fibers, combined in accordance with rigid G-E specifications. It has a minimum of sizing to assure thorough impregnation of the fabric. Impregnation is accomplished through a pressure process which completely controls varnish viscosities, oven speeds, baking temperatures, and the conditioning of the base cloth.

#### Made only for cables

The G-E varnish is a high-grade, asphalt base, heat- and corona-resistant product. It's made by G.E. specially for use in cable insulation. Another advantage of the varnish is its "oiling out" characteristics which leave an oily film on the surface of the finished insulating cloth. This film serves as a lubricant to protect against tape tears due to bending of the cable during installation.

General Electric is the only wire and cable manufacturer that prepares its own varnished cloth, using materials and processes developed in its own laboratories.

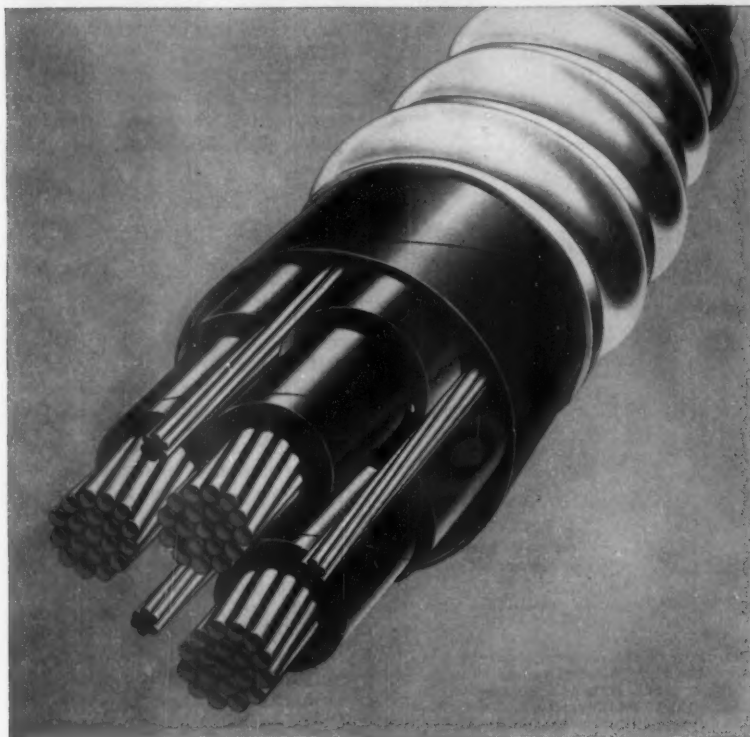
*Progress Is Our Most Important Product*

GENERAL  ELECTRIC

# General Electric



## NEW CABLE CONSTRUCTION



### NEW CONSTRUCTION GIVES ADDED VALUES TO G-E INTERLOCKED ARMOR CABLE

New features have been added to the construction of G-E Interlocked Armor Cable—GE No. 1799 DG varnished Dacron† glass tape insulation, Flamenol\* jackets on individual conductors, and built-in ground wires. Here are the advantages of each:

1) Varnished Dacron glass insulation: Offers outstanding electrical stability and low-moisture absorption. Reduces insulation thickness, permits higher conductor temperatures. No shielding is required up to 8,000 volts.

2) Flamenol jackets: Protect insulation against moisture, flame, oils, acids, alkalis, ozone, and weather. Provide phase identification by numerals. Simplify termi-

nating and splicing on non-shielded cables . . . only a lug and end seal are required.

3) Built-in ground wires provide a low-resistance ground circuit, a low-reactance fault return path, a positive relaying circuit, and positive and convenient equipment grounding.

These important new features are now added to the time-proved advantages of General Electric interlocked armor cable in a General Electric interlocked armor cable system—lower material cost, reduced space requirements, reduced materials handling, ease of installation, reduced installed costs. For more information, see your local G-E distributor or mail the coupon.

### Complete line of cables with new insulation now available

These cables with GE No. 1799 DG varnished Dacron glass insulation are now available:

*SI-12348: 600-volt power cable*

*SI-12350: 5000-volt power cable*

Single or multi-conductor. Either braided over all for open wiring or installation in conduit in dry locations; or lead-sheathed for installation in conduit or ducts in wet locations.

*SI-12381: 15-23 Kv Power Cable*

Three-conductor. Lead sheathed for installation in conduits or ducts in wet locations.

*Armored Cables—Submarine, Dredge, Borehole*

Three-conductor, lead-sheathed for moisture protection; wire armored for mechanical protection under water and for vertical suspension.

*Aerial Cable*

Three-conductor, individually insulated and jacketed, preassembled to the messenger.

\*Registered Trade-mark General Electric Company.  
†duPont Registered Trade-mark.

General Electric Company  
Wire and Cable Department  
Section W244-1018  
Bridgeport 2, Conn.

Please send me complete information on  
G-E cables now made with GE No. 1799  
DG varnished Dacron glass insulation.

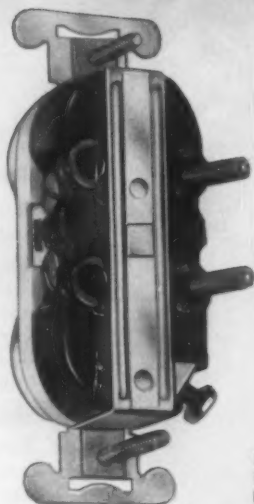
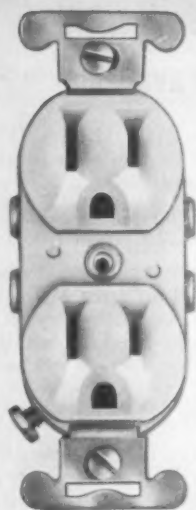
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# NOW! Leviton adds back and side wired devices to the specification (5000) grade line!



No. 5096  
Duplex U-Ground  
Parallel receptacle

See us at Booths 58 and 59 NECA Convention, Fontainebleau Hotel.

## LOOP IT OR DO IT THE EASY WAY!

LEVITON back-and-side wired devices offer two types of connections. Loop it the standard way, or clamp it for back-wiring—the new simple and modern way that gives you a connection that is electrically right and

mechanically tight. Either way you are assured the right kind of power to carry heavy duty loads. Here is the maximum in performance at minimum cost...with absolutely no compromise in quality!

Back-and-Side Wired  
Devices Now Available:  
Rated 15A.—125V.  
(No. 5089 15A.—250V.)



No. 5062



No. 5074



No. 5088



No. 5089

## Just Check These Features:

- All devices have double-wiping phosphor bronze contacts.
- Plaster ears—wide and break-off types.
- Grounding Screws on all U-Ground devices.
- Entire assembly solid-riveted for permanence.
- Heavily sectioned molded phenolic bases.
- Full underslung straps, completely rust-proofed.
- Easy back-wired installation for up to No. 10 wire.
- Strip gauge for obtaining maximum clamping.
- Individually packed with mounting screws attached to straps.

Meet U. L., C. S. A., and Federal Specifications  
All back-and-side wired devices in brown and ivory.

Listed by Underwriters' Laboratories

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**LEVITON**

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For your wire needs, contact our subsidiary AMERICAN INSULATED WIRE CORP.

the report of this special committee are recorded in the January 1935 edition of the News Bulletin of the International Association of Electrical Inspectors. Code recognition of the use of a grounded conductor without individual insulation has progressed from services, to range circuits, to clothes dryers and water-heater circuits, and it is definite that the 1959 code will extend such recognition to "wall mounted ovens and counter-mounted cooking units." Regardless of the conflict of opinion on the use of the bare neutral, it appears that the gradual increase in code recognition indicates a trend towards the ultimate objective which was proposed in 1933.—B.A.McD.—10/59/3

## Wireways

**Q.** What is the intent of the Code Panel concerning the 20% fill factor in Section 3624 on wireways?

1. Why just 20% fill?
2. Does the 20% factor include insulation of conductors?—C.C.R.

**A.** Wireways may be considered as special extensions of raceway systems. Taps and splices may be made within these wireways. If some limitations are not imposed on the system design at its initial installation, it may be found that as additions are made to the system at some later time, we soon reach a point where these wireways become overcrowded and also develop electrical hazards.

These wireways are rather flexible wiring systems permitting additional extensions to the system to be made rather easily. This 20% factor and also the limitation of 30 power and/or light conductors tends to give some control over this flexibility so that the wireway does not become too crowded with conductors, taps and splices.

Incidentally there was a recommendation for the 1959 code that this 20% factor be changed to correspond with the generally accepted 40% fill factor. This was given much attention by the Code Panel but was finally left as in the previous code (1956 NEC). Just what was involved in these discussions is unknown to the writer and it is possible that some panel member or other interested party may wish to comment further on this point. If such comment is forthcoming the writer will relay it to the readers of this column through some future discussion of the problem.



tired of replacing  
rusted conduit?  
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This Can't  
Happen to  
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**KRALOY PVC**  
Conduit!

## KRALOY PVC CONDUIT

permanently  
rust proof!

Tired of replacing conduit that has rusted out? Next time use KRALOY PVC Conduit...and forget it. This revolutionary new conduit of PVC (rigid, unplasticized polyvinyl chloride) is making startling changes in the electrical contracting field. Contractors and municipal engineers are finding that light weight KRALOY, with its ease of handling, high impact strength and long life proves to be far superior, safer and far more economical than conduit of other materials. A precision-extruded product, inert KRALOY Conduit is impervious to electrolytic action.

A non-conductor, KRALOY is ideal for both communications and power applications—under ground or above ground. Flexural strength permits easy contouring. Its smooth interior wall makes fishing easy. High impact rating guards against earth movement and shocks of all kinds. See how light-weight KRALOY PVC compares to the weight of heavier aluminum and steel conduit:

**KRALOY PVC CONDUIT VS. ALUMINUM AND STEEL CONDUIT**  
U. L. required minimum weight per 100 ft. including couplings, lbs.

Trade Size	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"	5"	6"
KRALOY PVC	15.0	20.0	29.0	40.0	47.0	63.0	101.0	131.0	159.0	187.0	253.0	326.0
ALUMINUM	27.4	36.4	53.0	69.6	86.2	115.7	182.5	238.9	287.7	340.0	465.4	612.9
STEEL	79.0	105.0	153.0	201.0	249.0	334.0	527.0	690.0	831.0	982.0	1334.0	1771.0

KRALOY PVC Conduit is sold only through  
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For complete information on KRALOY PVC Conduit and installation directions, mail the coupon or write to Kraloy Plastic Pipe Co., Inc., 4720 Washington Blvd., Dept. EW-9, Los Angeles 22, Calif.

K-59-25

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TOLEDO PIPE THREADING MACHINE CO. TOLEDO 4, OHIO

The answer to the second question is yes. Thus for example, in a 2½-in. by 2½-in. wireway we have a total cross-sectional area of 6¼ sq ins. 20% of this is 1.25 sq ins. The overall area of a No. 8 RH conductor (including insulation and covering) is .076 sq ins. The maximum number of No. 8 conductors would be

1.25/.076 or 16.5 conductors.

The maximum would be 16 Type RH No. 8 conductors. This is less than the 30 conductors permitted so we satisfy this limiting factor also.—B.Z.S.—10/59/4

## Readily Accessible

**Q.** Article 2351a reads that the disconnecting means shall be at a readily accessible point nearest to the entrance of the conductors either inside or outside the building wall. May the disconnecting means be installed in any of the following locations provided it is at the point nearest to the entrance of the conductors?

a. In a kitchen cabinet where dishes will be placed in front of the disconnecting means?

b. In a utility room that is under a carport? Utility room door can be locked.—T.B.F.

**A.** I would say that both locations are not "readily accessible." The code defines "Readily Accessible" as:

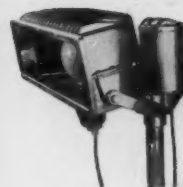
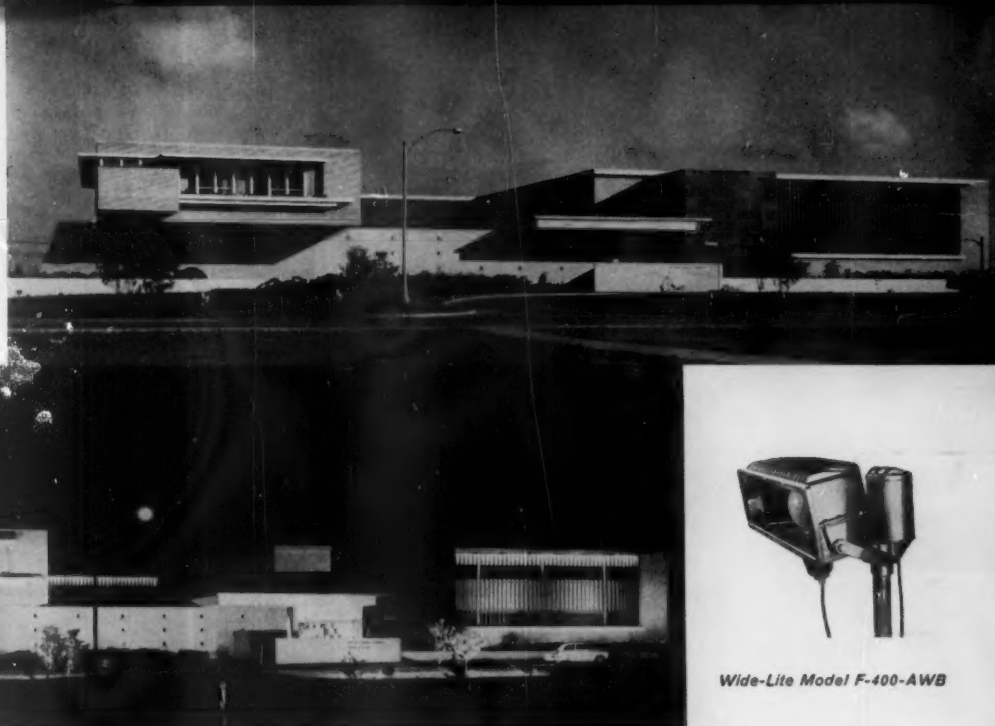
"Capable of being reached quickly, for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc."

In both cases I would say you would have to "remove obstacles" to obtain ready access to the disconnecting means. In the kitchen the dishes would definitely be an obstacle to getting at the disconnect. In the utility room, obtaining the key would certainly be an obstacle at times.—B.Z.S.—10/59/5

## Floating Boat Dock

**Q.** What type wiring material and method of installation can be approved for wiring on a small floating boat dock for small boats located on a lake where the water level varies several feet with the rise and fall of the lake?—J.M.A.

Decorative and security  
lighting for the Administration  
Center of Dow Chemical  
Company's Texas Division is  
achieved through use of 15  
Wide-Lites placed around  
the building.



Wide-Lite Model F-400-AWB

## creative lighting calls for **WIDE-LITE**

Dramatic lighting effects are easily achieved when Wide-Lites are selected as the lighting engineer's basic tool.

Designed especially to enhance the unique characteristics of color-corrected mercury vapor lamps, Wide-Lites bring *new dimension* to decorative lighting. They produce broad patterns which may be overlapped to provide smooth, even coverage without concentric circles, hot spots, or dark shadows to mar the architectural harmony of a building. The patterns are unusually uniform and may be accurately plotted to determine the exact number of units needed to provide any desired illumination level.

Ruggedly constructed from cast aluminum alloy, Wide-Lites are finished in aluminum epoxy paint for corrosion control. All outdoor models are sealed with tempered glass lenses, and relamping is accomplished without disturbing the seal of the lens. Exclusive built-in heat radiating fins limit lamp temperatures to the most efficient range. Sizes range from 100-watt to 1000-watt, and a choice of reflectors is available on all models.

To assist you in planning dramatic decorative lighting effects, Wide-Lite engineers have prepared a unique group of transparencies which read directly in Wide-Lite beam footcandles. Write today for your set... and a copy of Catalog 444 which gives information on the complete Wide-Lite line of indoor, outdoor and special application fixtures.



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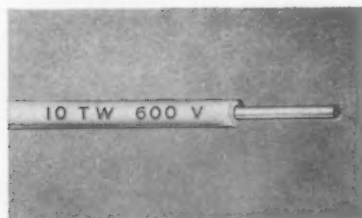
## Industrial



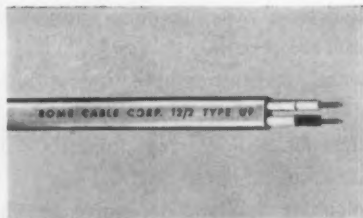
## Commercial



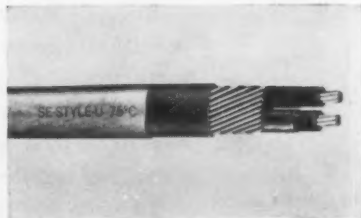
# Water and insulated wire ... do they mix?



**Industrial • Rome Synthinal 901 building wire**—600 volts, Type TW. Polyvinyl chloride insulation, approved by UL for use in wet or dry locations at 60 C. Also available for appliance use at 80, 90, or 105 C, depending on wire size. Synthinal 901 was used extensively for the low-voltage wiring in the plant shown here, for its proven resistance to moisture—in addition to its resistance to heat, oils and corrosives. These low-voltage applications include not only control circuits but also the general wiring of office and warehouse buildings and mill equipment. Also ideal for low-voltage circuits in refineries, chemical plants, other industrial plants where electrical wiring is exposed to extreme moisture or corrosives. For high-voltage industrial use, Roxone A (butyl) insulation is recommended.



**Commercial • Rome's FlexAll Type UF**—600 volts, nonmetallic jacket. Insulated and jacketed with Rome Synthinal polyvinyl chloride compound. In commercial applications—such as the laundry shown here—FlexAll provides positive protection against drizzling moisture, strong detergents, acids or alkalis. Cost is low. Corrosion resistance is high. Also widely used for underground between-building wiring; farm, industrial and residential yard lighting; livestock buildings and packing houses; and for breweries, cold storage and ice plants. Available in single-, two-, or three-conductor construction. Meets NEC requirements for direct-in-earth burial and interior wiring in wet or dry locations.



**Residential • Rome Type SE, Style U, Service Entrance Cables** can be used for long life and high weather resistance in residential applications like the one shown here. NEC recognizes the use of this wire for attachment to the side of the building from the weatherhead to meter equipment. Conductors are insulated with a heat- and moisture-resistant RHW insulation. The insulated conductors are then given an over-all covering for mechanical protection. An appropriate neutral conductor is applied concentrically over the insulated conductors and is covered with a protective weather- and moisture-resistant tape. The final covering consists of a combined pre-saturated cotton and glass yarn braid with a gray flame- and weather-resistant finish. You can paint it to match the house. Mail this coupon!



## Residential



When insulated wire is exposed to water, it's not how it *looks* but how it *works* that determines its moisture resistance.

Electrical stability of the system may be seriously impaired by water that has penetrated the insulation, causing dielectric losses. *This can happen long before you actually see any damage being done.*

At Rome Cable, work constantly goes on toward developing better compounds for moisture-resistant insulations. Innumerable scientifically accelerated tests are conducted—some last from 2 to 5 years—to determine the electrical stability of new insulations.

The greater the moisture resistance of an insulation, the less electrical properties deteriorate from long immersion in water.

The results of these tests have aided the development of the building wires shown at the left. Rome recommends them to you as ideally suited for use in industrial, commercial and residential wiring where moisture is a problem. Mail this coupon!

### ROME CABLE DIVISION OF ALCOA

Department 7-10, Rome, New York

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THE  
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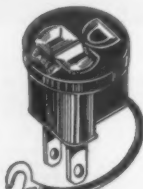
Here is one line, one quality, one high standard of repeat performance you can depend on and trust. Specify Eagle, install Eagle—do the job with complete peace of mind, without doubts. You are protected by Eagle's great 40-year reputation of trouble-free performance. Eagle's single high standard assures you the same trusted, protecting quality, shipment after shipment. Specify these Eagle grounding devices and other finest quality Eagle products on your next order.

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**827**  
15A-125V

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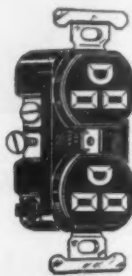
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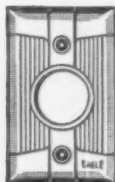
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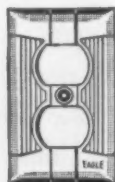
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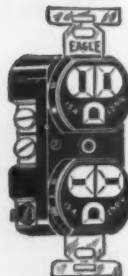
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No. 132



No. 816



No. 829

"PERFECTION IS NOT AN ACCIDENT"

**EAGLE ELECTRIC MFG. CO., INC.**

LONG ISLAND CITY 1, NEW YORK

**A.** Conductors shall be approved for wet locations such as is covered under Section 3102 (310-1 and 310-2, 1959 code). As an example, an underground feeder with mechanical protection for such conductors may be used. Mechanical protection may be conduit with flexible connections such as can be made with flexible conduit when not subject to mechanical injury. All equipment shall be properly grounded using grounding type receptacles where receptacles are installed. The service to the floating boat dock is usually a cable approved for wet locations with a reel or other method of extending and shortening the cable from the service equipment or meter location which is generally located on a meter pole or a building located above the water level to the boat dock. Overcurrent protection shall be provided at the dock itself as well as at the service equipment due to the fact that in some cases the protective equipment located on the pole or building above the water line will not be readily assessable to persons on the dock itself. Such protective equipment on the dock is to be of the weatherproof type if not properly protected from the weather. The entire metallic part of the installation is to be bonded together and grounded according to Article 250, National Electrical Code.—R.E.W.—10/59/6

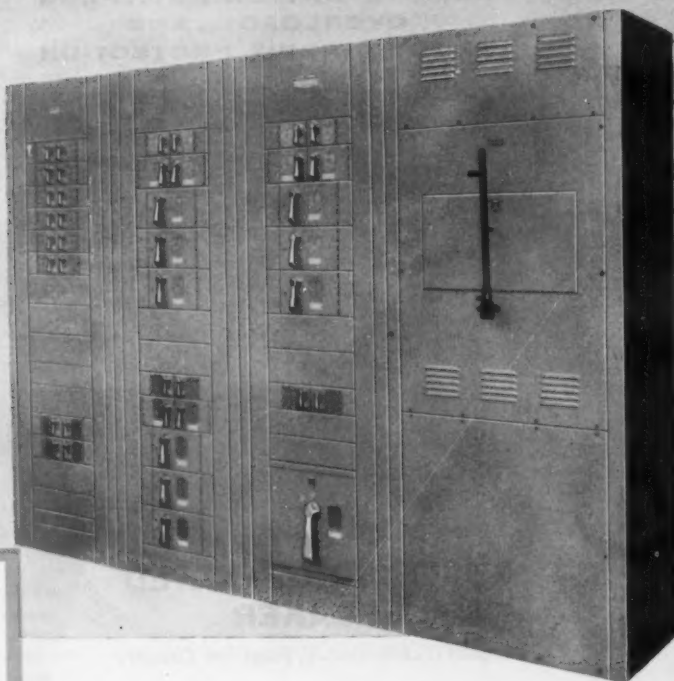
## Grounding Trailers

**Q.** Your interpretation of the following problem with applicable code reference and rulings would be especially appreciated. The questions concern the supply of electrical power to mobile homes, connecting devices and method for grounding mobile units.

Original plans and specifications called for a 3-wire 120-volt or a 4-wire 120/240-volt device, both grounding types, for each coach. To meet the requirements of Standard 501 and to minimize the hazard to persons and property it was decided that a polarized device on a 4-wire cable would be needed for a safe, flexible connection—each unit then being treated as an appliance.

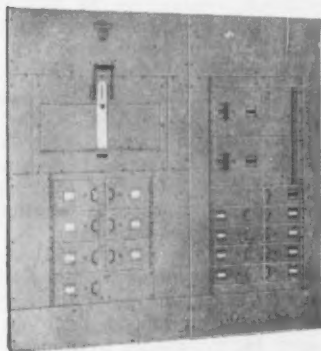
During construction, the writer was away on another job. The best qualified local contractor with the services of a registered engineer was recommended for the job. Three-blade 50-amp receptacles and caps, caps not grounded, for cable to branch connections were furnished. Supposedly the coach and

**STANDARDIZED UNITS** for "tailor-made" jobs  
assure quicker delivery, faster and easier installation!



**S-A-W TYPE  
SHUTLARK SWITCHBOARD**

Heavy duty, safety-type  
specially designed for the  
most severe use.



**KLAMP SWITCHFUZ SWITCHBOARD**

Features both disconnect  
and fuse apparatus.



**CIRCUIT BREAKER SWITCHBOARD**  
The ultimate in automatic circuit protection.

## FRANK ADAM SWITCHBOARDS

Factory-assembled standardized units—pioneered and developed by Frank Adam—permit installation of "tailor-made" switchboards in far less time for considerably less money. Interchangeable branches can be rearranged to allow for the addition of more protective units as load demands increase.

Easier to install, too! Oversize wiring gutters—accessible from front and back—allow fast and trouble-free installation!

Heavily electro silver-plated copper bars . . . rigid welded frames . . . quicker delivery . . . plus a dozen other outstanding features give you an impressive number of reasons for installing Frank Adam Switchboards.

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NEW! 2-WAY

## control versatility

REMOTE SWITCHING...PLUS  
OVERLOAD...AND  
SHORT CIRCUIT PROTECTION



### SOLENOID OPERATED BREAKER

**Compact... Low-Cost... Simplified Circuitry**

Here's the answer to sure, low-cost remote panelboard control for lighting and branch distribution circuits... for limited service starters and contactors. Choice of signal?... timer, automatic, pushbutton.

Electrically-operated dual-solenoid actuators. Mechanically-held for failure-proof service with standard breakers. Protection includes thermal overload and short circuit. Trip-free design.

Interrupting capacities to 10,000 amp rms!

2 pole — 3 pole — 4 pole

240 — 480 — 600V AC

125 and 250V DC

State control voltage and current ratings when requesting quotations.

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**ELECTRIC CORPORATION**

205 Willis Street BEDFORD, OHIO

its electrical system are to be grounded to the neutral conductor. The contractor feels the method of grounding, "meets code requirements. The use of an additional grounding conductor cabled into the supply cord is not needed and is a practice in decline at present."

The county in which the project is located has no electrical inspector other than assigned by federal agencies or insurance companies on jobs of particular interest to them. The utility company, of course, has recourse to its own approval.

Other installations in the community appear to be of a more determined "devil may care" design. Since a pending municipal annexation is quite likely to include the property within the corporate limits, any comments from more distant points would be most helpful. —J.S.R.

**A.** When the N. E. Code does not specifically cover an electrical wiring application, and the National Fire Protection Association has covered same through a recommended standard, it is considered sound policy to follow the rules established by the NFPA. In the event of an electrical fault resulting in personal injury or fire, the responsibility may rest on the shoulders of the people who are intimately concerned with the installation, and when procedures, with a background of recognized authority, are followed the responsibility for a safe installation is considered to be satisfied.

According to Section 2561 of the code, the grounded circuit conductor on the load side of the service disconnecting means shall not be used for grounding equipment, cable armor, or metal raceways, except by special permission as covered by Section 2557-c, or as covered by Section 2560 for the frames of electric ranges and clothes dryers. In view of the foregoing, and in the absence of an administrative authority who is delegated to enforce the code and grant "special permission," it appears that the grounding of the trailer and its electrical equipment to the circuit grounded conductor is in violation of the code. The question of "special permission" is covered under the paragraph covering "Enforcement" which appears in the introduction to the code.

Generally speaking, the use of the grounding type receptacle with a grounding conductor integral with the cord is constantly increasing. This may be verified by ref-



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FIXTURES INSURE

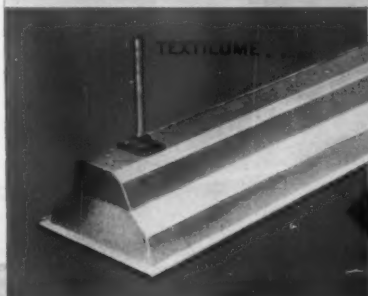
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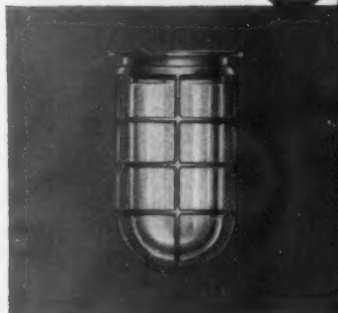
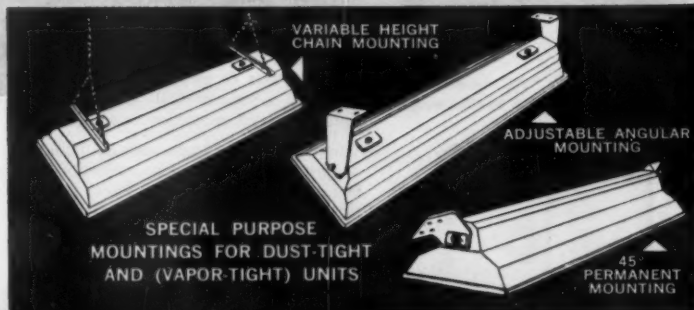
Withstands textile mill humidity; features smooth water-shedding, permanently non-corroding hood with no cracks or crevices for moisture accumulation. Seamless, porcelain-enameled glass-like finish. Easily cleaned, retains brilliance, high reflectivity indefinitely.

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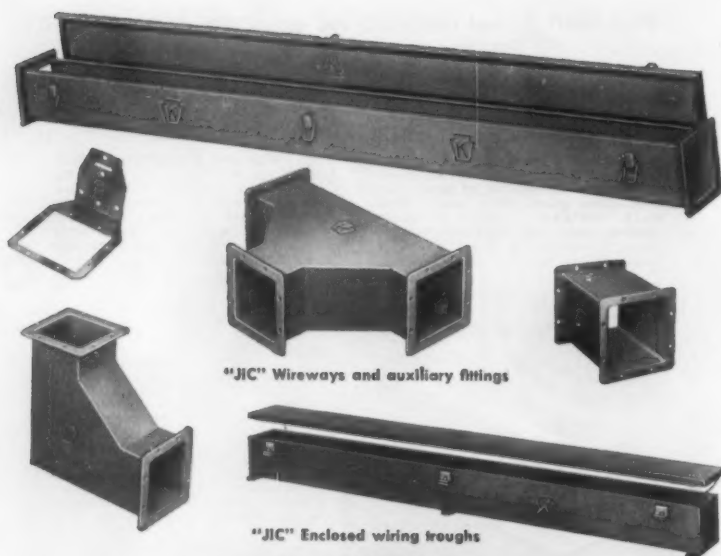
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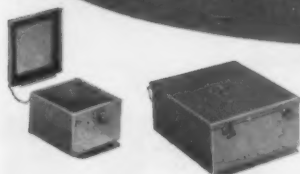
"JIC" Enclosed wiring troughs



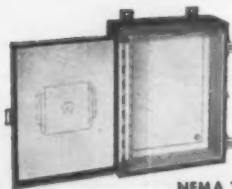
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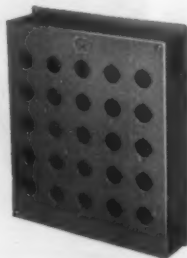
"JIC" Terminal and Pull Box Enclosures



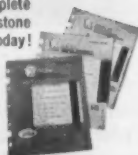
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erence to the recent amendments to the 1956 Code which extend this method of grounding in a residential occupancy to a considerable extent.

According to NFPA No. 501, a standard for the wiring of trailer coaches and trailer courts has been developed. The occasion for such a standard is prompted by the peculiar characteristics which distinguishes trailer wiring from conventional residential wiring. The following excerpts taken from this standard indicate an authoritative method of procedure.

**"453. CONDUCTORS.** No grounding of the supply or circuit conductor shall be made within or on the trailer.

**"455. GROUNDING METHOD.** The requirement for grounding shall be accomplished by means of a grounding noncurrent-carrying conductor, green in color, contiguous with the supply conductors, and terminating in an approved grounding terminal at the line end of the supply cord."

These rules apply to the wiring of the trailer coach. The following rules apply to the wiring of trailer courts:

**"1420. GROUNDING.** The system and exposed noncurrent-carrying metal parts of equipment and conductors shall be grounded in accordance with the provisions of the National Electrical Code. The grounded conductor of the trailer supply system shall be effectively grounded at each trailer supply center. (Note: The trailer supply center contains one or more attachment plug receptacles with appropriate overcurrent protection.)

**"1430. RECEPTACLE FOR TRAILER CONNECTION.** The court operator shall provide for each trailer unit a 25-amp minimum, multi-wire receptacle with appropriate overcurrent protection, conveniently located for the trailer supplied. The grounding terminal of the receptacle shall be connected to the grounding conductor required in Article 1420.

**"1440. SUPPLY CORDS.** At each supply center there shall be provision for preventing strain on the supply cord being transmitted to the connections between the plug of the supply cord and the receptacle."

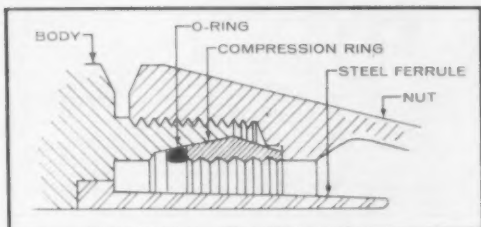
A summary of these rules indicates to me that the grounded supply conductor shall not be grounded at the trailer, but at each trailer supply center. The grounding of both the supply grounded conductor and the metal equipment shall



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K/W 3 Conductors Interlocked Armor Cable Spec. 808-S vs. 3 Copper Cdrs. in Steel Conduit  
COST AND WEIGHT COMPARISON—1000 FT.

600V RHW 75°C RUBBER 3 Copper Cdrs. in Steel Conduit							600V ALUMINUM INTERLOCKED ARMOR Aluminum Conductors, 90°C, Butyl Insulation						SAVINGS WITH ALUMINUM			
Wire Size	Amps.*	Trade Size In.	O.D. Inches	Area Sq. In.	Total Wt.—Lbs.	Total Cost—\$	Wire Size	Amps.**	O.D. Inches	Area Sq. In.	Total Wt.—Lbs.	Total Cost—\$	% Bonus Ampacity Alum. over Copper	SAVINGS (1) \$	Weight Savings Lbs.	Space Savings %
2	115	1¼	1.66	2.17	2,860	903.	1	120	1.44	1.63	850	713.	4.3	190.	27	2,010
1	130	1½	1.90	2.82	3,570	1,155.	1/0	135	1.53	1.84	960	806.	3.8	349.	43	2,610
1/0	150	2	2.38	4.44	4,660	1,457.	2/0	160	1.63	2.07	1,115	926.	6.7	531.	57	3,545
2/0	175	2	2.38	4.44	4,960	1,609.	3/0	180	1.74	2.38	1,285	1,093.	2.9	516.	47	3,675
3/0	200	2	2.38	4.44	5,350	1,814.	4/0	205	1.87	2.74	1,550	1,265.	2.5	549.	43	3,800
4/0	230	2½	2.88	6.51	7,730	2,508.	250	230	2.04	3.27	1,840	1,522.	0	986.	65	5,890
250	255	2½	2.88	6.51	8,190	2,883.	300	255	2.16	3.66	2,080	1,751.	0	1,132.	65	6,110
300	285	2½	2.88	6.51	8,700	3,171.	350	285	2.27	4.04	2,325	1,870.	0	1,301.	70	6,375
350	310	3	3.50	9.62	10,860	3,752.	400	305	2.37	4.41	2,560	1,998.	-1.6	1,754.	88	8,300
400	335	3	3.50	9.62	11,370	4,053.	500	355	2.56	5.14	2,990	2,260.	6.0	1,793.	79	8,380
500	380	3	3.50	9.62	12,390	4,748.	600	395	2.79	6.11	3,545	2,615.	3.9	2,133.	82	8,845
700	460	3½	4.00	12.57	15,930	6,459.	750	455	3.02	7.16	4,175	3,151.	-1.1	3,308.	105	11,755

\* Based on 1956 N.E. Code \*\* 90°C Conductor—40°C Ambient. Note—Comparison of 75°C RHW and 90°C Butyl K/W Spec. 107. Current prices, 4-29-59.  
(1) Savings based on increased cost of copper and steel over aluminum cable. Weights and prices for 1000 ft.

#### 1. LESS COST

You realize important savings on *materials* with KW Aluminum Interlocked Armor Cable because (1) it gives you greater current-carrying capacity per dollar, (2) the nature of its aluminum armor eliminates costly conduit. Also, you save on *costly labor* because KW's corrosion resistant aluminum armor holds up—keep to a minimum, even in highly corrosive areas.

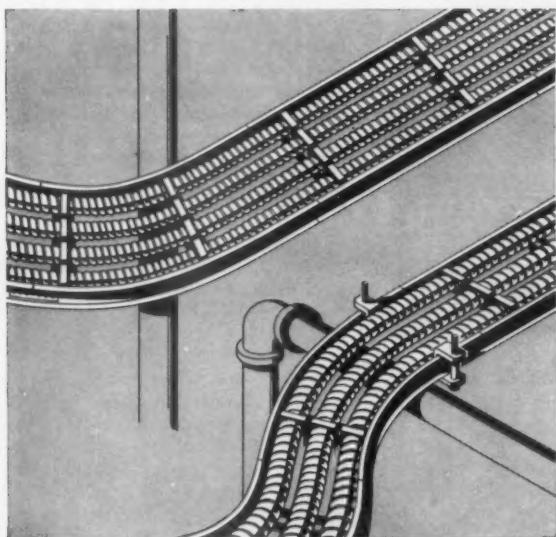
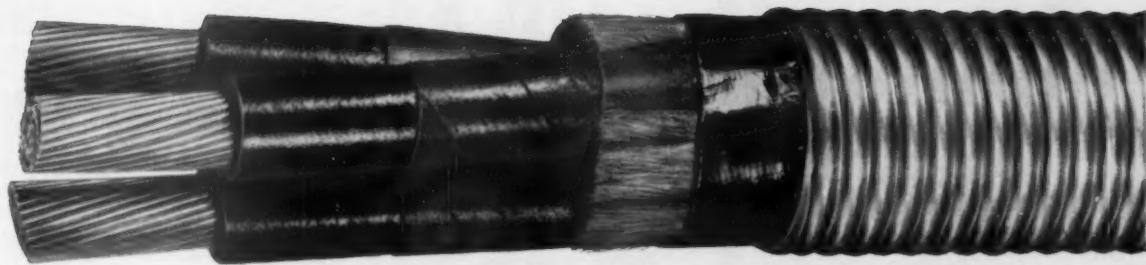
#### 2. LESS WEIGHT

Any interlocked armor weighs far less than heavy, bulky steel conduit. But KW gives you *additional* weight savings because its armor is aluminum—weighing only 1/3 as much as steel or bronze. Moreover, because the conductors are also made of aluminum, they are less than half the weight of copper conductors that carry the same amount of current.

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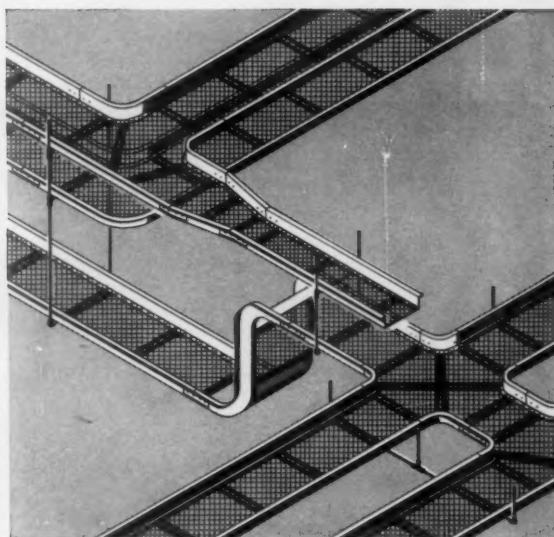
For complete information, call the Kaiser Aluminum sales office or KW distributor listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, Calif.





### 3. FASTER INSTALLATION

The light weight and supreme flexibility of KW Aluminum Interlocked Armor Cable mean easier handling, cut installation time in half. It can easily be bent horizontally or vertically around impeding objects and laid in longer lengths, eliminating the need for frequent splicing. In addition, because its diameter is less than conventional conduit systems, compact KW cable can bring space savings of up to 54%.



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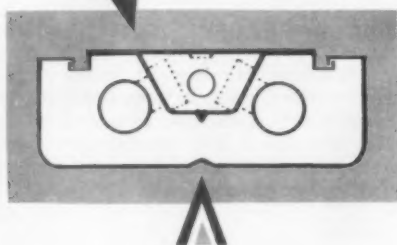
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be made through a separate grounding conductor, contiguous with the cord, at the trailer supply center. Contiguous does not mean that the grounding conductor is integral with the cord, but I do not believe that the use of a grounding conductor integral with the cord is intended to be denied.

If the community involved comes within the limits of a municipality which recognizes by law the N. E. Code as a standard for electric wiring and equipment installations, the status of NFPA No. 501 may be questionable if it is not also recognized. Section 410 of this standard provides as follows: "Wherever the National Electrical Code and the Standards for Trailer Coaches have unlike requirements, the requirements in the Trailer Coach Standard shall apply." It appears that a similar statement should be made in the N. E. Code, or at least a recommendation that the provisions of the standards should be followed.—B.A.McD—10/59/7

## NEC Official Interpretations

Three interpretations of sections of the National Electrical Code have been reviewed and released by the NFPA Electrical Correlating Committee. The National Electrical Code Committee, NFPA, has announced the effective date of these interpretations to be June 11, 1959.

Subjects covered by the interpretations cover: circuit breakers on a line supplying more than one building (Interpretation No. 456); current-carrying capacity of a circuit breaker controlling a motor (No. 457); voltage of a branch circuit supplying a roadway lighting system (No. 459).

Official text of the interpretations follow.

### Interpretation No. 456

**Statement:** A mill consisting of four buildings under single management is supplied from a 440-volt line through a 800-amp circuit breaker. The supply line goes first to a building where a 1,000-amp bus is tapped to supply overhead wires to three separate buildings. The 800-amp main circuit breaker is mounted some distance away from the first building and controls a run of 750,000 circular mil conductors in parallel. The tap from the 1,000-amp bus in the first building to overhead wires is 500,000 circular mils. Individual switches control the taps to each of the three secondary buildings.

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*Every breaker is  
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Browse along our production line and it will be apparent why this circuit breaker has earned the reputation as the safest and most dependable on the market. Following are five of the dozen or more exhaustive checks and quality controls the Pushmatics undergo — over and beyond those required by Underwriters'.

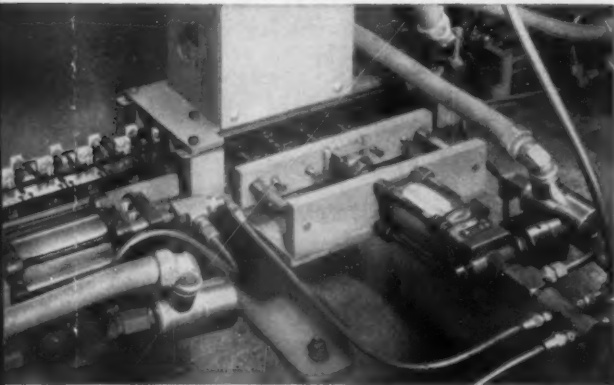


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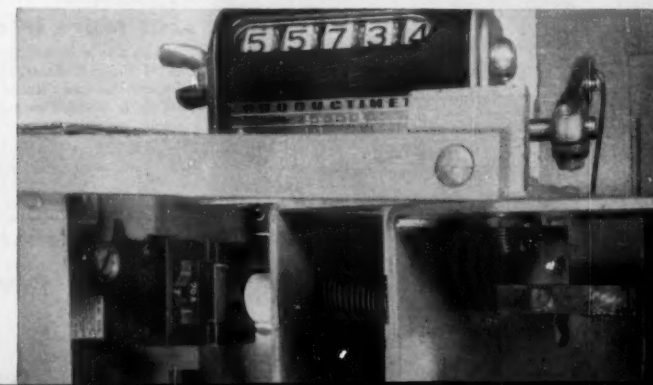
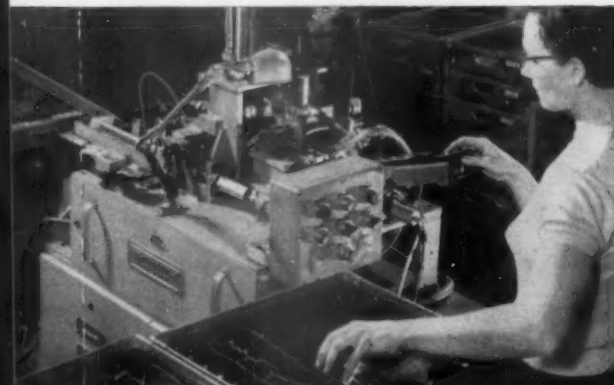
**2. MECHANICAL BREAK-IN** After assembly every Pushmatic is operated 50 times to make absolutely sure it functions well mechanically. Ten break-ins would be adequate . . . the extra 40 give you that much more assurance that it will never fail in manual or automatic operation.

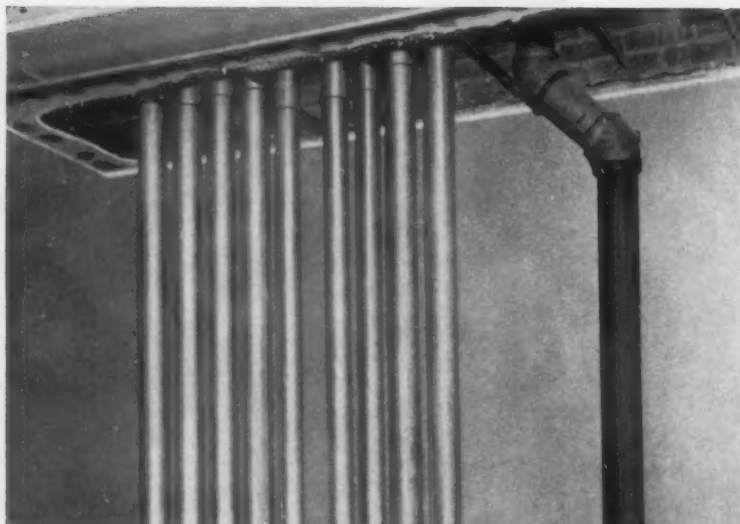


**3. CALIBRATION UNDER LOAD** Brought back to its "set" temperature, each breaker is checked at 200% of rated current, and again at the equivalent of 125% of rating. Check Boards are accurate to 1/10 of a second. Samples from each production run are also tested at 100% of rating.

**4. SHORT CIRCUIT TEST** Being thermal-magnetic devices, Pushmatics then undergo severe short circuit currents to test the instantaneous trip time of the magnetic element. If a breaker fails to trip within .02 seconds, it is automatically rejected by the machine. Extra safety, extra performance.

**5. ENDURANCE TEST** Underwriters' Laboratories run periodic endurance tests on BullDog Pushmatics®. The requirement — 10,000 operations, 6000 under load and 4000 with no load. But BullDog constantly checks out the breakers at 50,000 or more operations. *End trouble calls. Use Pushmatic!*





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are made with  
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and names of Reynolds Aluminum Electrical Rigid Conduit outlets, call your nearby Reynolds Sales Office or write Reynolds Metals Company, Box 2346-ET, Richmond 18, Virginia.

Also write for descriptive brochure.

Watch Reynolds TV shows—"ALL-STAR GOLF" and "ADVENTURES IN PARADISE"—ABC-TV

**Question No. 1:** Would the 800-amp circuit breaker mounted some distance from the first building be readily accessible under the intent of paragraph "d" of Section 2351?

**Answer:** No.

**Question No. 2:** Are the 500,000 circular mil cables between the bus-bar in the first building and the overhead wires properly protected by the main 800-amp circuit breaker?

**Answer:** No.

**Question No. 3:** Does Section 2302 apply to this combination of buildings under single management?

**Answer:** Yes.

## Interpretation No. 457

**Statement:** A 300-hp, 735-amp, 208-volt, 3-phase (nameplate rating) hermetic compressor motor is controlled by a motor starter and motor disconnect switch. The switch is an 800-amp molded-case circuit-breaker supplied from a 1600-amp protected feeder.

A control circuit is provided in the starter which is adjusted to limit the motor load current to not more than 735 amps.

**Question No. 1:** Does the above arrangement conflict with the literal text of Section 4403 in so far as current-carrying capacity is concerned?

**Answer:** Yes.

**Question No. 2:** Does the above arrangement comply with the intent of Section 4403 in so far as current-carrying capacity is concerned?

**Answer:** No.

**Question No. 3:** Does Section 4347 apply to the above arrangement?

**Answer:** Yes.

**Question No. 4:** If the answer to Question No. 3 is "yes," does the above arrangement comply with the intent of 4347?

**Answer:** No.

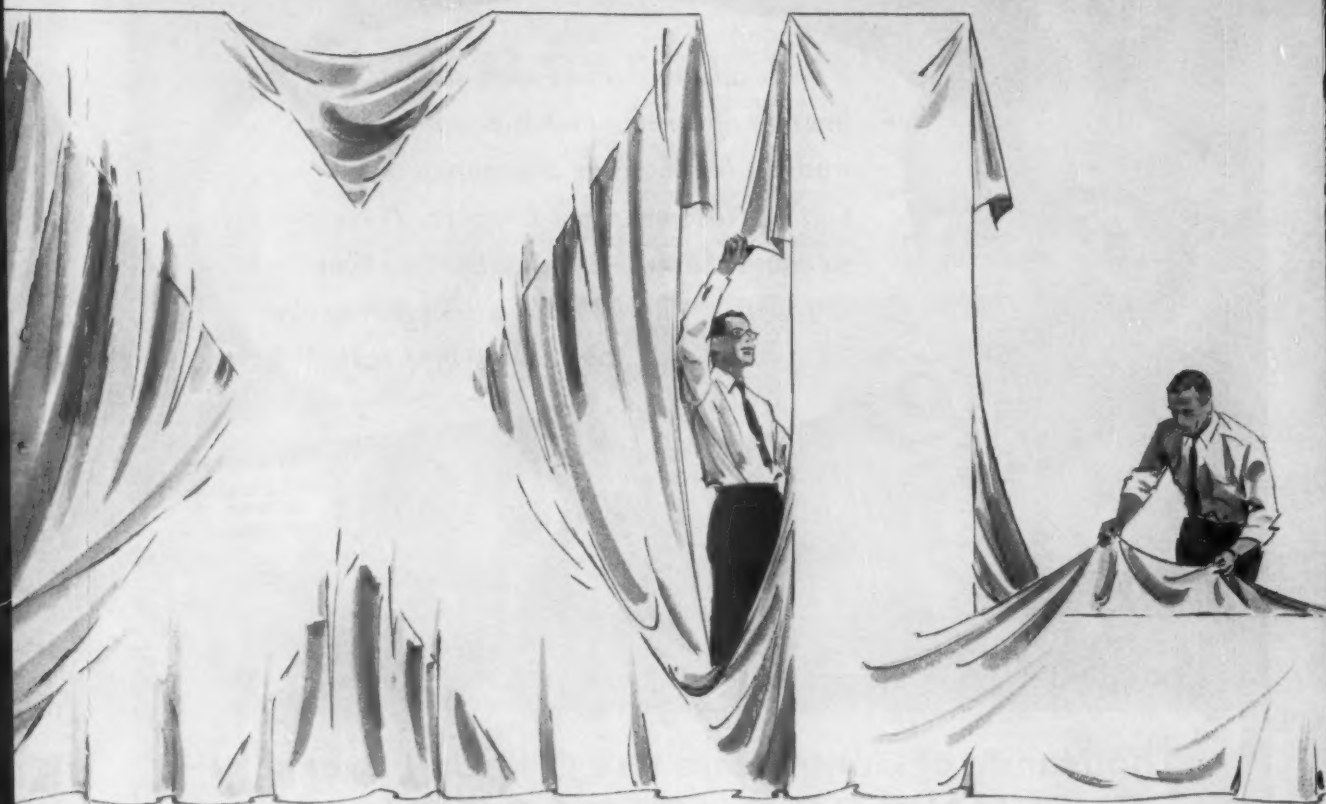
## Interpretation No. 459

**Statement:** A roadway lighting system serves the roads and driveways at a sewage treatment works. The wiring is underground in a trench and there is no question regarding its suitability. The branch circuit supply is 480-volt, 3-phase, ungrounded. It feeds fluorescent lamps operating at 265 volts. The lamps are mounted on standards, such as are commonly used for street lighting.

**Question:** Is Section 2113 of the National Electrical Code applicable to this installation?

**Answer:** No.





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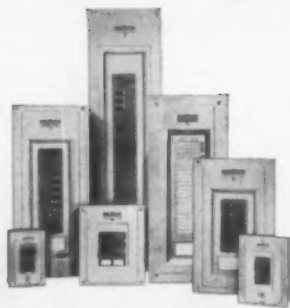
Says: Chris Devevo, Electrical Contractor, Unionville, Connecticut



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C-H breaker performance pays off the same way on large as well as small jobs. Prominent housing projects across America are C-H Unit Breaker equipped, to the satisfaction of builders, contractors and home owners.

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The "package" may look the same on good watches and not-quite-so-good ones. The same goes for circuit breakers. But the difference shouts at you when you buy on performance, *not* on looks and claims. Successful contractors—thousands of them—find that the performance of C-H Unit Breakers amounts to an extra "edge" that insures customer satisfaction and betters their business. Get that extra edge for yourself—feature C-H Unit Breakers! See your nearby Authorized Cutler-Hammer Distributor, or write for the new selection guide, *Handi-Log*, Pub. EN100-V241, Cutler-Hammer Inc., Milwaukee 1, Wisconsin.



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## IES Technical Conference Held in San Francisco

Continuing progress in an ever-changing, ever-growing, ever-better lighting industry was emphasized during the week of September 6th when approximately 950 delegates from the United States, Canada, England and France convened in San Francisco for the 1959 Technical Conference of the Illuminating Engineering Society. Highlights of the meeting included an impressive Progress Report of lighting developments during the past year, the always-popular "finals" in the national MMILJ Contest, the awarding of the Society's Gold Medal to Dr. N. A. Halbertsma of The Netherlands, elevation of eight IES members to Fellow status, reports of stewardship by officers completing their terms of service, the election of Joseph B. Browder of Atlanta to head the Society for the coming year, plus the presentation of over 40 papers pertaining to developments in light sources, applications, calculations and research.

As emphasized in the absorbing Progress Report, which was presented by a 20-man committee headed by E. A. Lindsay, General Electric Co., Cleveland; co-chaired by M. K. Strang, Curtis Lighting of Canada, Toronto, and coordinated by Robert T. Tipton, Consulting Engineer from San Francisco, the past year has contributed many outstanding developments to a lusty, thriving lighting industry. A year of accomplishment, it has witnessed higher levels of illumination being accepted across the nation; new lamps and fixtures coming into being, and progressive thinking being reflected by achievements in research, design and application.

Among the newer fixtures displayed during this 2-hour presentation were those utilizing novel plastic prismatic refractors, that provided higher levels of illumination with controlled brightness; improved ventilation principles; wedge-shaped extruded aluminum louvers to assure low brightness when viewed lengthwise; longitudinal deflectors shielding reflector lamps to provide both upward and downward illumination for offices and classrooms; industrial type fixtures incorporating colored plastic

side inserts to aid traffic control, and telescopic spring-loaded door frames that automatically adjust to exact widths of troffer openings in ceilings. Likewise demonstrated and discussed were fixtures incorporating air conditioning and lighting in the same unit; new drop-prism border-lens luminaires providing well-distributed light patterns with upward edge-lighting to illuminate adjacent ceiling areas;

radio-static shielding glassware for use with fluorescent fixtures in places where direct radiation from lamps might interfere with sensitive electronic instruments; formed vinyl louver panels with circular openings and varying degrees of transparency, also louver panels consisting of circular metal cylinders in natural, white or colored finishes.

As illustrated by striking colored

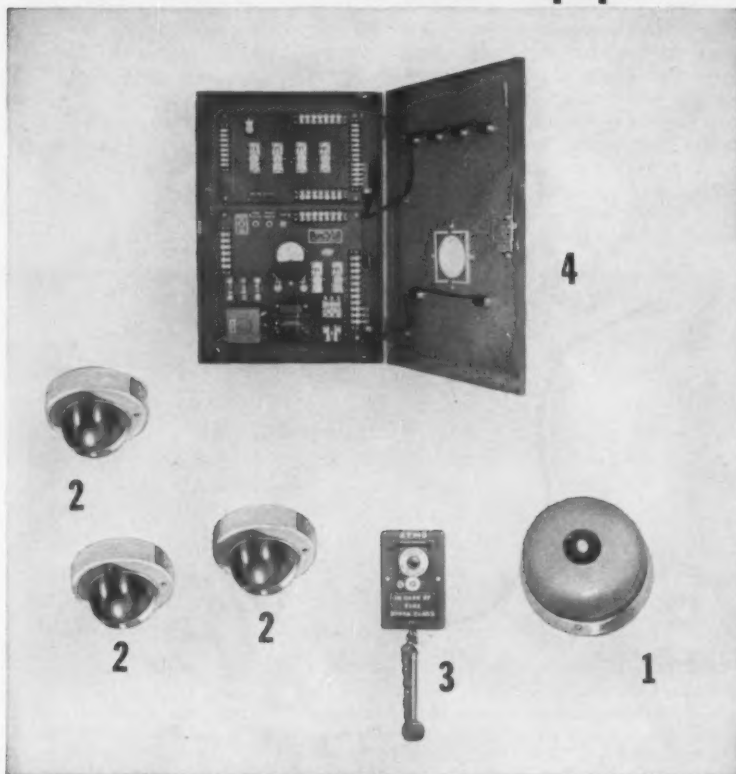


**FELLOWS OF IES**, a distinctive classification held by only 133 members in the 10,000-member lighting Society, this year witnessed the admission of the six men shown above; also Stanley R. McCandless, New York, N. Y. and Priscilla Presbrey, Bloomfield, N. J., who were unable to attend the San Francisco conference. Pictured above in the usual order are: George W. Clark of Wheeling, W. Va.; Berlon C. Cooper of New York, N. Y.; Elton A. Lindsay of Cleveland, Ohio; Richard D. Bradley of St. Louis, Mo.; Lawrence E. Johnson of Minneapolis, Minn.; and Robert T. Dorsey, Cleveland.



**MMILJ CONTESTANTS** in Class II Division of annual IES contest included (first row) Armand Zitelli, Duquesne Light Co., Pittsburgh; L. Ralph Bush, Lighting Consultant, Atlanta, Ga.; Fred Rosenquist, Public Service Co. of Colorado, Denver; Neil J. Thompson, Kansas Power and Light Co., Topeka, and Rollo G. Williams, Century Lighting, New York City. Backing these men are John C. Epperson, Peerless Electric, and Lloyd Dehrer, Buonaccorsi and Murray, Consulting Engineers, both of San Francisco, who jointly won first prize in this division; O. V. Stephens, Brown & Root, Houston, Texas (a proxy for Donald L. Copeland, Crouse Hinds); F. M. Farley, Benjamin Electric Mfg. Co., Portland, Ore.; Charles E. Strahan, Jr., Mississippi Power and Light Co., Jackson; Willard C. Brown, General Electric Co., Cleveland, Ohio (proxy for H. S. Williams, George F. Schatz and Associates, Cincinnati), and Joe Thomas, Canadian General Electric Co., Montreal, Quebec, Canada (proxy for Gerard Denis, The Shawinigan Water and Power Co., Juliet, P.Q.).

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**PRESIDENT-ELECT** Joseph B. Browder of Atlanta, Georgia, paid tribute, at the Society's Technical Conference in San Francisco, to the more-than-700 IES members who are presently working on various task committees re-evaluating recommendations as result of recent scientific findings, research developments, development of new light sources and luminaires.

slides; stores and offices are now adopting highly-coordinated ceiling systems, floating luminous and transilluminated panels, new low-brightness troffers, retractable banks of spotlights to highlight wall displays, luminous backing panels for glassware displays, plus numerous novel modular elements to heighten visual interest.

In the industrial field, far-higher levels of localized lighting for critical-seeing tasks are being obtained with the use of PAR lamps; as, for example, in a welding plant where banks of 500-watt PAR-64 narrow-beam spotlights provide up to 15,000-fc on the task area.

As further indicated by slides and exhibited equipment, outdoor illumination has received impetus from such new developments as a 1000-watt color-improved mercury lamp operated over-wattage at 1500 watts to produce high-level intensities on sports fields; impact-resistant plastic-bowl streetlight luminaires that can withstand such juvenile-impelled objects as rocks; new post-top luminaires of modern design for parking areas and roadways; inexpensive open-bottom glass refractors for modest-investment farm applications; weather-proof ballasts in seamless aluminum casings and die-cast covers for highway use, also transilluminated panels on store fronts and poster billboards having brightness values up to 750-ft-lamberts provided by 1500-ma lamps.

This outdoor-lighting category also included flush condenser-discharge high-intensity airport approach-lighting units; a recessed reflector lamp combining mirrors and

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**ROBERT R. TIPTON**, consulting electrical engineer, San Francisco, and coordinator for the IES Progress Report Committee's impressive 2-hour presentation at the 1959 annual meeting, was kept busy backstage during the show, changing product set-ups on a revolving stage for demonstration to an SRO audience of interested delegates.

above-ground luminous break-away plastic housings which would collapse without damage to airplane landing gear if struck, also a new 2-kw xenon arc lamp operated from a 28-volt dc source to produce a brightness of approximately 50-million candlepower in an 18-in. searchlight.

Pre-set stage-lighting programming received a boost from the introduction of a fully-automatic control system utilizing punch-cards for repetitious recreation of effects, while switchboard illumination received an assist from a line of tungsten flat-end T-2 lamps with filaments placed nearer the bulb end to give 60% more endwise candlepower.

Unique in the incandescent field, a tubular all-quartz pencil-thin lamp was displayed to show the successful application of iodine to catch particles of tungsten as they evaporate from filaments, and, through this regenerative principle, produce almost near-perfect lumen maintenance throughout the entire lamp life.

In the fluorescent field, a new translucent base material is now available to reduce bulb end-losses formerly associated with opaque materials, while extra-high-output lamps are finding greater acceptance for outdoor lighting in cold climates when jacketed to keep lamp temperatures at higher levels.

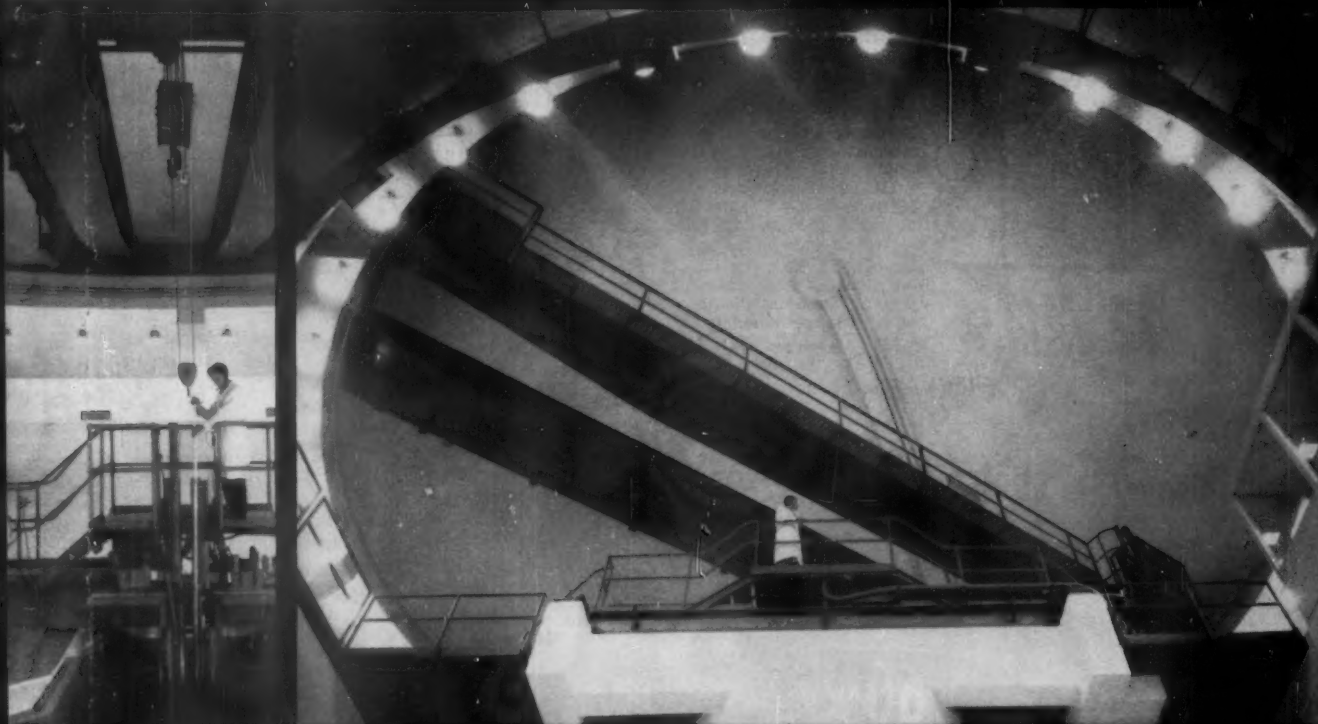
In discussing high-frequency advances, Lindsay stated that the first commercial installation of 1500-cycle static lamps and ballasts had

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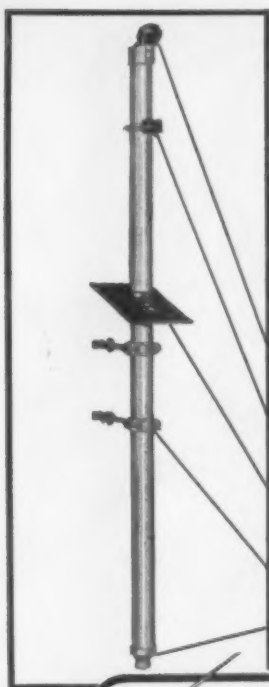
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**3** Flexible Synroflashing — Made of flexible neoprene to absorb vibration. Mast can't work loose, damage shingles, or cause leaks. Won't rot, peel or crack in any weather. Available for 1½, 1½, 2 and 2½" pipe.

**4** Mounting brackets — Exposed parts corrosion-resistant aluminum alloy. Shoulder eye fits flat. Lock set screw gives additional grip. Meets installation requirements.

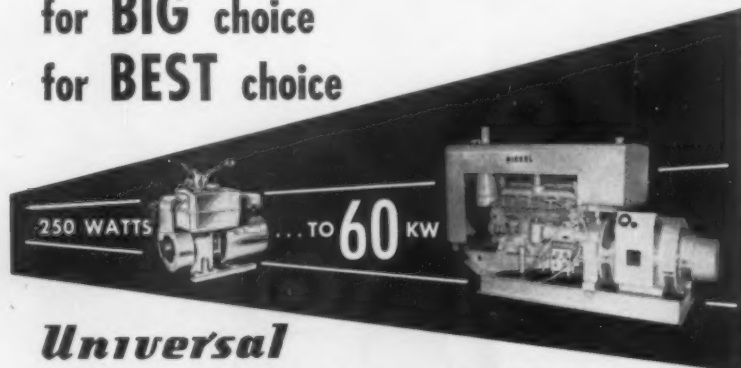
**5** Offset reducer — Corrosion-resistant aluminum alloy. Fits 1¼" and 1½" hubs to a 2" or 2½" pipe riser.

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**RETIRING PRESIDENT** George J. Taylor of New York, N. Y., urged greater cooperation of the Society with colleges and universities to create greater interest among undergraduates in the field of illumination as a career.

raised efficiencies 20%. And, referring to electroluminescence, he displayed a large-dimension thin metallic lamp that could form changing letter-and-number patterns for sign use.

Reviewing advances in residential lighting, delegates were shown new dimmers, luminous backlighted screens, luminous architectural elements, plastic-shielded fluorescent striplights in small cross-sections with ballasts contained in prolongation of the lamps, also several new bulb shapes and decorative finishes to promote esthetics in the home.

### Gold Medal Awarded

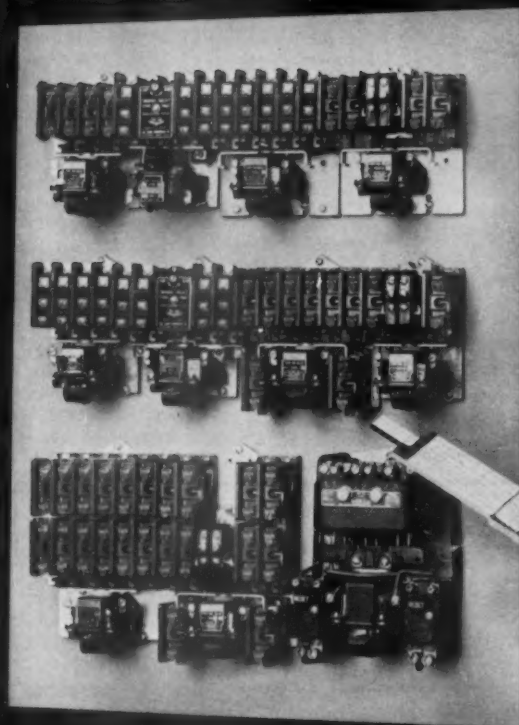
The Society's highest award, the IES Gold Medal, this year was presented to the Dutch pioneer of eye hygiene through scientific lighting, Prof. N. A. Halbertsma of Zeist, The Netherlands. Distinguished in the engineering field as an inventor, teacher, writer and world-traveller lecturer on illumination, Halbertsma was the first to recommend designs for indirect lighting equipment shortly after the first practical incandescent lamp was perfected 45 years ago. It was also Halbertsma who invented the first carbon arc lamp for use in picture projectors. A founder of the Dutch IES in 1923, he was elected president of the world society of lighting engineers, the CIE, in 1939 and again in 1948.

### Eight Members Honored

In recognition of outstanding contributions to the lighting industry, eight members were honored this year with citations and pins signifying status as Fellows of the IES; a distinction currently held



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**JUDGES** of "My Most Interesting Lighting Job" competition at national IES Technical Conference included (for Class II—Non Residential) John Neidhart, The Miller Co., Meriden, Conn.; R. F. Hartenstein, Ohio Edison Co., Akron; Raymond L. Smart, Boston Edison Co., and Ray E. Dahlin, Southern California Edison Co., Los Angeles. Reviewing the points by which contestants were to be rated is (left) J. Carl Wilson, Toronto, Ontario, Canada.

by only 133 members in this 10,000-member Society.

Included in this select group were: Richard D. Bradley, Day-Brite Lighting, Inc., St. Louis, Mo., who was cited for "outstanding contributions to visual comfort"; George W. Clark, Sylvania Electric Products, Wheeling, W. Va., for "valuable contributions to design and application of lighting equipment"; Berlon C. Cooper, associate editor, *Electrical Construction and Maintenance*, for "outstanding reporting of technical progress in lighting"; Robert T. Dorsey, General Electric Co., Cleveland, Ohio, for "contributions to the development of light sources"; Lawrence E. Johnson, Northern States Power Co., Minneapolis, Minn., for "important attainments in the coordination of light and architecture"; Elton A. Lindsay, General Electric Co., Cleveland, for "valuable contributions to industrial lighting"; Stanley R. McCandless, Century Lighting, Inc., New York, N. Y., for "outstanding contributions to the art of lighting the American stage"; and Priscilla Presbrey, Westinghouse Electric Corp., Bloomfield, N. J., as a "skilled practitioner in the laboratory and the home."

### Reviews IES Objectives

In his keynote address at the opening session, George J. Taylor, retiring IES president and research vice president of Day-Brite Lighting, New York, paid tribute to the work of technical committees and researchers such as Blackwell and Finch, whose findings and recom-

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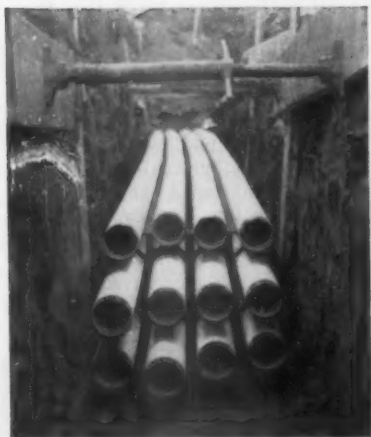
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**WILLIAM F. BLITZER**, Lightolier, Jersey City, N. J., was one of three featured speakers at a Residence Lighting Forum staged during the IES Technical Conference at the Hotels Fairmont and Mark Hopkins, San Francisco, in September.

mentations are gaining widespread public recognition throughout the United States and Canada. He also warned delegates that trained lighting engineers were in short supply, and that 3000 lighting jobs would "go begging" for lack of available men within a 5-year span. Scientific research teams at universities in California, Ohio, Texas and New York have recently revealed that the human eye needs far more light and less glare to function efficiently, he said, but we are not going to be able to act with fullest effectiveness on their laboratory findings unless we can promptly attract new lighting designers and engineers to this field.

In reviewing specific contributions of various IES task committees such as those related to roadway, office, school, stores and the Handbook, president-elect Joseph B. Browder stated that these assignments were monumental, for they involved thorough re-evaluation of formerly accepted standards and recommendations due to recent scientific findings, research developments, availability of new light sources and luminaires, plus advanced thinking in the application.

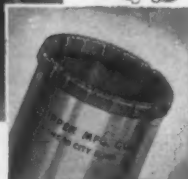
Browder gave unstinted credit to the more-than-700 IES members who are presently working on various national technical committees, adding that in addition to the opportunities so afforded for learning and teaching, these Society assignments were also the basis for meeting people with common interests, establishing valuable business contacts and cementing new friendships.



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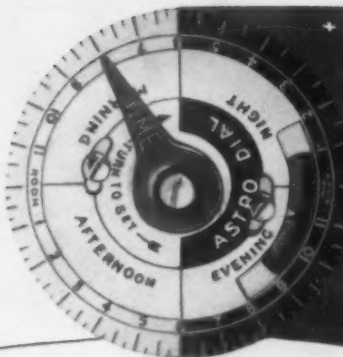
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## QUIET TRANSFORMERS? these decibel ratings speak for themselves —

in a *whisper*

Designed sound levels for representative sizes of standard Hevi-Duty dry type transformer.



SINGLE-PHASE		THREE-PHASE	
KVA	Decibel Rating	KVA	Decibel Rating
1.0	33	6.0	38
7.5	33	9.0	40
10.0	40	15.0	44
20.0	44	30.0	43
37.5	44	45.0	45
75.0	49	112.5	45
100.0	50	150.0	47

Write for Bulletins 100 and 200 for further details.

**HEVI-DUTY ELECTRIC CO.**  
MILWAUKEE 1, WISCONSIN

INDUSTRIAL FURNACES, ELECTRIC AND FUEL • DRY TYPE TRANSFORMERS  
CONSTANT CURRENT REGULATORS



**PHILLIP F. O'BRIEN**, University of California, Los Angeles, presented a paper on lighting calculations at the IES annual Technical Conference, while comments on his paper were contributed by two delegates in attendance; Bill Jones, General Electric Co., Cleveland, and Roy Jones, Westinghouse, Los Angeles.

Joe Browder, who had been elected as up-coming IES president in a pre-Conference mail ballot, is assistant to the vice-president in charge of sales, also sales manager for the Georgia Power Co., Atlanta.

Other new IES officers introduced at the conference included James R. Chambers, sales manager for the lighting products division of Appleton Electric Manufacturing Co., Chicago, who begins a 2-year term as the Society's vice president; Charles W. McCormick, commercial sales manager for the Connecticut Light and Power Co., Berlin, Conn., who becomes general secretary; G. Franklin Dean, supervising engineer of lighting service for the Toronto Hydro-Electric System, re-elected treasurer, and Richard G. Slauer, manager of marketing services in the fixture division of Sylvania Electric Products at Wheeling, W. Va., who continues as the Society's vice president.

Also elected were two new directors, who will serve 3-year terms, and four regional vice presidents, who will serve two years each. Newly-elected directors are J. Samuel Hamel, consulting engineer, Glendale, Calif., and William P. Lowell, Jr., manager of the commercial engineering department, Sylvania Electric Products, Salem, Mass. New regional vice presidents are John B. Deck, Jr., lighting engineer for the Texas Power and Light Co., Dallas, Southwestern region; Carman D. Miller, director of lighting utilization in the commercial sales department, Duquesne Light Co., Pittsburgh, East Central region; Cecil L. Cannon, partner of Ruff and Cannon, lighting manufacturers' representatives, Atlanta, Southeastern region, and Lloyd S. Reed, principal of L. S. Reed and Co., Denver, Inter-Mountain region.

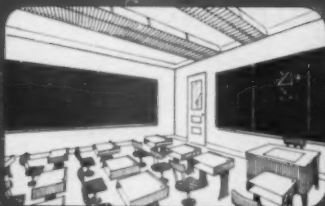
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**The High Quality Fixture  
At LOW COST ...  
FLUORESCENT or  
SLIMLINE**



SHIELDING  
24°C x 45°L  
41°C x 45°L

**MAXIMUM  
EFFICIENCY!  
NO TOOLS ARE NEEDED  
TO REMOVE SIDE PANELS  
OR HINGED LOUVERS.**



**For Schools**



**For Stores**



**For Offices**

Marlou's improved SCHOOLER is designed for easy installation and to provide a top quality luminaire for excellent general lighting in school rooms, offices, stores and other commercial lighting applications. The "schooler" is die formed and constructed of 20 gauge cold rolled steel for structural stability. All reflecting surfaces are finished in the finest baked white enamel. Side panels may be obtained in perforated steel, plain steel or plastic. When pendant mounted the light distribution is 45% up and 55% down. May also be mounted flush to ceiling. Threaded swivel type stems provide for accurate alignment of "Schoolers" in continuous rows.

Write for catalog of Marlou's complete line of lighting fixtures. We will, upon request, engineer any projects.



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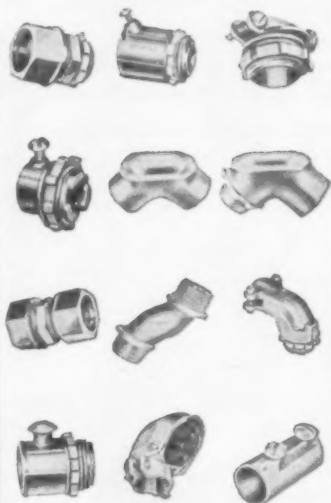


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**PRECISION  
Engineered  
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For temporary  
or permanent installation.



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## Edward J. White

Edward J. White, president of Edward J. White Company, Newark, N. J., died on August 27. He was 68.

A registered professional electrical engineer, Mr. White founded the White electrical contracting company 32 years ago.

Mr. White was active in Newark and Essex County civic and business organizations. He was treasurer of the Northern Manufacturing Co. of Newark, a former president of the Essex Electrical League, and a member of the Power Group of American Institute of Electrical Engineers, Illuminating Engineering Society, New Jersey Chapter of the National Electrical Contractors Association, National Small Businessmen's Association, and the International Association of Electrical Inspectors. He was also a former president of the Newark A. C., and a member of the Newark Chamber of Commerce.

## NISA News

Presidents and secretaries of most of NISA's 39 chapters were present at the 2nd Annual Chapter Officers' Conference, held in St. Louis on September 25 and 26 at the Clayton Inn. J. Arthur Turner Jr., NISA international vice-president, was the presiding officer at the meeting at which leaders of the electrical equipment service shop industry discussed mutual problems and received instruction in conducting chapter affairs.

NISA will be an exhibitor at the 2nd Annual Conference on the Application of Electrical Insulation, at the Hotel Shoreham, Washington, D. C. and the Plant Maintenance and Engineering Show, at Philadelphia's Public Auditorium, January 25-28, 1960. Local chapters of the association will provide manpower for demonstrations of winding techniques and to answer questions about the organization.

The steel strike postponed a tour of a local mill scheduled by the NISA Central District Chapter, of Chicago, for September 15. On September 8, the group met at Graemere Hotel for dinner and a viewing of the new Wagner Electric Corp. film, "Motors in the Making."

Members of the NISA Great Lakes Chapter held their annual





**Fires of electrical origin cost an appalling \$150,000,000 each year.**

## **RIGID STEEL CONDUIT** ***protects electrical wiring permanently!***

The best way to avoid risk is to specify rigid steel conduit for your electrical raceways. With more than 50 years of service in all kinds of installations, steel has proved its ability to combat the hazards inherent in any wiring system: open circuits, short circuits, and induced currents.

RIGID STEEL CONDUIT has *strength* and *toughness*. It protects the wiring from physical damage both during and after installation.

RIGID STEEL CONDUIT has *good conductivity* and

*positive coupling design*. It grounds out induced currents without danger.

RIGID STEEL CONDUIT has *over-all economy*. Low original cost, low installation cost, long trouble-free service.

Protect your wiring — protect your buildings — permanently. Be sure it's *rigid steel conduit*! Your steel conduit distributor can give you full details.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

# **BETHLEHEM STEEL**





## QUALITY INCANDESCENT REFLECTORS FOR 37 YEARS INDUSTRIAL LIGHTING



Quadrangle offers America's most complete line of RLM reflectors as well as many other type reflectors. There is a wide range of sizes and a large variety of socket fittings. Many utilize the Quad exclusive Easy-Tach disconnect socket.

## FLOOD-LIGHTING



Quad floodlights incorporate design and manufacturing features that are the result of years of research and engineering. There are five different types and more than one hundred and twenty different unit designs to choose from.

## SIGN-LIGHTING



There are more than 15 Quad sign reflectors, in a multitude of shapes and sizes, to accommodate lamps from 60 to 1500 watts. There is a size and design for illuminating the smallest signs to the largest outdoor display bulletins.

All Quad Reflectors are rust-proof, weatherproof, finished lustrous porcelain enamel. Available with Easy-Tach or Quick-Detachable horizontal, vertical, feed-through or box-type easy-to-wire sockets.

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City \_\_\_\_\_ State \_\_\_\_\_

outing on September 16 at Saginaw Country Club, Saginaw, Mich. The group convened at Henry Electric, the host shop.

C. Y. Thomas, Spencer Chemical Co., was the guest speaker at the NISA Heart of America Chapter's meeting in Joplin, Mo. October 9-10. Others on the program were NISA engineer A. C. Roe, who showed slides about cross connections and discussed windings; *NISA News* editor Horace Barks, of Horace Barks Publications, St. Louis, who spoke on "How Advertising Affects the Motor Repair Shop"; NISA executive vice-president Joseph M. Harrington, who discussed "The NISA Program, Present and Future"; and NISA international president Horace C. Blenkhorn, who spoke on the problems of the motor service industry.

Knoxville, Tenn., motor shops, including Industrial Electric Co., Southern Armature & Motor Works, Tennessee Armature & Electric Co. and Tennessee Electric Motor Service, were hosts to the NISA Mid-South chapter's fall meeting on September 11-12. It was the first meeting in the city since 1953. J. Arthur Turner Jr., of Tampa Armature Works, Tampa, Fla., the NISA international vice-president, was guest speaker. The group toured the Oak Ridge National Laboratories and Knoxville shops.

R. H. Grady, manager, security division, Aerojet-General Corp., Sacramento plant, described rocket engines at the August 14 meeting of the NISA Northern California Chapter, at Capitol Inn, Sacramento.

The 1959 NISA Yearbook, a directory of the association's members with detailed information about each shop plus information about the association, its standards, history, rules and code of conduct, has been issued by the organization's national office, 7730 Carondelet Avenue, St. Louis 5, Mo. Copies of the yearbook may be purchased for \$5.

Balancing, maintenance and sales were topics discussed at the September 11-12 meeting of the NISA North Central Chapter at the Frederick Martin Hotel, Moorhead, Minn. Horvick Electric Co. was the host shop. A breakfast was given by Phelps Dodge and D. A. Schultz companies, of Minneapolis. A film, "Building a Rewind Business," was

*Universal*

## THIEL'S HUMP PAT. 2885169 "NAIL-IT"

For fasteners that hold.  
This THIEL hump drive NAIL-IT strap has a sturdy head to insure an easy drive without bending... will not pull out. Zinc plating prevents rust made of #8 heavy wire. Available in copper plating for plumbers use.  
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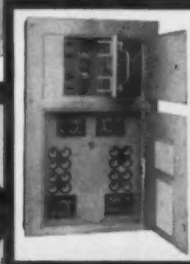
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FUSIBLE OR CIRCUIT BREAKERS  
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ANOTHER ADVENTURE  
IN LOW-VOLTAGE WIRING  
WITH

# REMMIE REMCON

and  
**ALEC TRISHUN**

"REMMIE SAVES TIME  
AND SELLS UP"

YOU SEE,  
WE'RE FINISHING  
THE ATTIC  
TO ADD TWO  
BEDROOMS.

AND YOU WANT A  
LIGHT AT THE TOP OF THESE  
STAIRS, WITH SWITCHES  
ON BOTH LANDINGS,  
RIGHT?

HOW ABOUT SWITCHES IN EACH BEDROOM, TOO?  
SINCE YOU'RE GETTING REMCON, YOU CAN HAVE  
AS MANY SWITCHES AS YOU WANT CONTROLLING  
ONE LIGHT...AND WITH PILOT-LITE  
INDICATION, TOO!

MMM—  
WONDERFUL!

REMMIE, WHILE  
YOU INSTALL THE  
FIXTURE BOX, I'LL  
CUT THE HOLE FOR  
THE DOWNSTAIRS  
SWITCH.



AFTER THE  
FIXTURE BOX IS UP,  
WE WIRE THE REMCON  
RELAY WITH THE BUILT-IN  
TRANSFORMER TO THE  
110-VOLT SERVICE.

MEANWHILE...

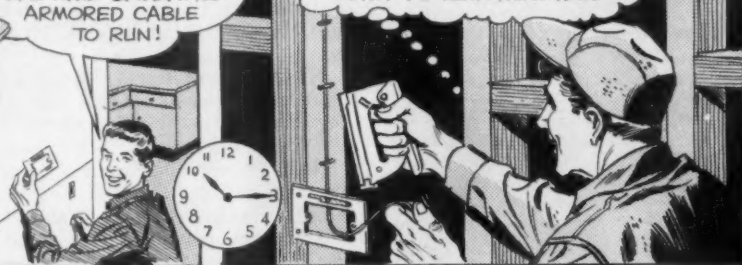


I'LL DROP  
THE SNAKE  
TO THE SWITCH  
POSITION  
BELOW. ALEC,  
YOU HOOK  
UP THE LOW-  
VOLTAGE (#18)  
WIRE TO THE  
SNAKE.

I GET IT! THEN YOU'LL  
PULL IT UP AND WIRE IT  
TO THE LOW-VOLTAGE END OF  
THE RELAY. BOY, REMCON WIRING  
IS A REAL TIME-SAVER. NO  
ARMORED CABLE  
TO RUN!



WHILE ALEC FINISHES WIRING THAT SWITCH,  
I'LL DROP ANOTHER SWITCH LEG FROM THE  
RELAY TO THE MB1. THEN WIRE THIS  
SWITCH...AND WE'RE DONE IN  
ONLY FIFTEEN MINUTES.



FELLERS! FIND OUT MORE  
ABOUT REMCON'S VERSATILITY...  
AND FIND OUT HOW YOU CAN  
WIRE WITH REMCON IN 1/3  
THE TIME IT TAKES WITH  
CONVENTIONAL WIRING.  
SEND THIS COUPON TODAY  
FOR MY FREE  
ELECTRICIAN'S MANUAL.



**REMCON**

A DIVISION OF  
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PLEASE SEND ME REMMIE REMCON'S NEW  
ELECTRICIAN'S MANUAL.

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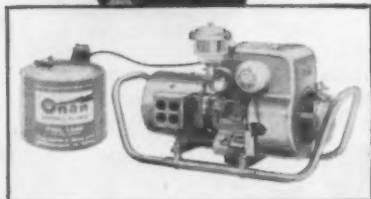
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## New 2500-watt Onan Electric Plant



### Special contractor's model; separate 5-gallon fuel tank

Supplies 2,500-watts A.C. . . enough for a crew of three men using electric tools . . . yet it weighs only 140 pounds!

New separate fuel tank holds 2½ times as much as regular mounted tank, saves refueling time. Fuel line is quickly detachable. You can move the plant without carrying along heavy fuel.

#### Ruggedly-built . . . quick starting

Powered by a dependable Onan 4-cycle, single-cylinder, air-cooled engine. Drip-proof, all-weather Onan generator is directly connected making a compact, rigid, smooth-running power package. No belts or couplings to cause trouble. Aluminum carrying frame, 4 plug-in outlet box, recoil starter and separate fuel tank are standard. Choice of 115, 230, or 115/230 voltages.

Other models from 500 to 200,000 watts.

Check your phone book for nearest distributor or write for information.



**D.W. ONAN & SONS, INC.**

3651 University Ave. S.E., Minneapolis 14, Minn.

shown by a Dow Corning representative. Speakers were: Bruce Shaffer, service engineer, Allis-Chalmers, who spoke on maintenance control; and Ralph Buscarello, manager, industrial balancer department, Stewart Warner, who talked on precision balancing. A Belden Manufacturing Co. film, "How To Sell Quality," was also shown.

The Puget Sound Chapter of NISA was host to the Northwest Conference at the Doric 6th Avenue Motor Hotel, Seattle, October 2-3, with members of NISA's Oregon and British Columbia Chapter attending.

R. C. Snow, assistant manager, Fafnir Bearing Co., New Britain, Conn., discussed motor applications of ball bearings at a meeting of the Quaker City Chapter of NISA at Beck's-on-the-Boulevard Restaurant on September 9. Dick Lehr has been named chairman of the program committee, assisted by Joe Roy. Other committee chairmen and their assistants are: membership, Jim Previty, chairman, Art Fowler, Dave Dunlap, and Mort Smith; publicity, George Wagner, chairman, and Frank Schaefer; budget-finance-by-laws, C. R. Durand, chairman, Joe Previty, John Neihart and Milt Eisenhardt; management, Clarence Chandler; ideas-research, C. J. Allen; marketing-sales survey, Paul Secrest; convention, Jack Persson.

A joint meeting of the Rocky Mountain and Utah Chapters of NISA will be held in Salt Lake City on October 16-17.

The annual fall conference of the Southeastern Chapter is to be held on October 29-31 at Raleigh, N. C.

NISA international president, Horace C. Blenkhorn was one of the speakers on the Southwestern Chapter's fall program, his topic "NISA, Present and Future." Other speakers included Bruce H. Shaffer, service engineer, Allis-Chalmers, maintenance controls; Ray Reading, chief magnet wire engineer, Belden Manufacturing Co., wire developments; James A. Pahres, Southwest Electric Co., Oklahoma City, metal molds for epoxy encapsulations; and H. B. Black, vice-president and trust officer, First City National Bank, Houston, retirement plans. Tours of Houston shops, an excursion trip on the Houston ship channel and a tour of San Jacinto Inn were included.

## MINERALLAC BEAM CLAMPS

FOR  
MOUNTING  
HANGERS  
ON I-BEAMS



Mounts Minerallac hangers No. 8 to No. 6 on I-beams safely without necessity of drilling holes. Made of heavy gauge zinc plated steel with deep drawn ribs to give needed strength, these durable, light weight beam clamps have ¼-20 tapped holes—will fit beam flanges up to ½ inch thick. Furnished with case-hardened set screw. Low cost.

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## HELWIG CARBON BRUSHES

Units have lifetime guaranteed See-Thru plastic drawers with moveable dividers. Both Handy-Kit and Cabinets complete with brushes for single phase motors, vacuum cleaners, mixers, fans, portable tools, etc. Units assure you have the right replacement stock on hand.

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RUSH BRUSH SERVICE.

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**Feathertouch  
SWITCHES**



Here is the ultimate in modern switch efficiency, beauty and long life for fine homes, schools, hospitals, hotels, restaurants, apartments, offices, and public buildings



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**NO OTHER  
SWITCH HAS  
ALL THESE  
IMPORTANT  
FEATURES:**

- Unique floating rocker-arm toggle
- Whisper-quiet, almost silent operation
- Patented cam action and pure silver contacts
- No wear; no heating up
- Maintenance-free performance
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- Smooth streamlined styling
- 100-year guarantee with free replacement under normal use

SWITCHES are available in single and double-pole, 3 and 4-way types; and the new Twin.

LUXURY-STYLED WALLPLATES come in rich ivory or brown plastic to fit all switches. Metal wallplates are available in all combinations and finishes.

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**H. J. THEILER CORP.**  
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**HERBERT E. COOK**, Executive Secretary of the Detroit Electric Assn. and member of the National Electric Week Committee, revealed 1960 promotion plans related to that important industry activity at the IAEI annual meeting.

## DATES AHEAD

**International Association of Electrical Inspectors—Southern Section**, Heidelberg Hotel, Jackson, Miss., Oct. 12-14; **Mississippi Chapter**, Heidelberg Hotel, Jackson, Miss., Oct. 12-14.

**11th Biennial Electrical Industrial Exposition**—Sponsored by Essex Electrical League; Armory, Elizabeth, N. J., October 10-12.

**National Electronics Conference**—Sherman Hotel, Chicago, Ill., October 12-14.

**Electrical Progress Show**—Sponsored by Electrical Association of Philadelphia, Convention Hall, Philadelphia, Pa., October 13-15.

**National Electrical Contractors Association**—Annual convention and 5th National Electrical Exposition, Fontainebleau, Eden Roc, Deauville and Carillon Hotels, Miami Beach, Fla., November 9-12.

**National Electrical Manufacturers Assn.**—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 9-13.

**Industrial Electric Exposition**—Sponsored by Electrical League of Western Pennsylvania, Penn-Sheraton Hotel, Pittsburgh, Pa., November 17-19.

**American Institute of Electrical Engineers**—Winter general meeting, New York, N. Y., January 31-February 5, 1960.

**16th Annual National Wiring Sales Conference**—Warwick Hotel, Philadelphia, Pa., February 25-26.

**National Association of Electrical Distributors**—Annual convention, Dallas, Texas, May 1-5.

**National Industrial Service Assn., Inc.**—Annual convention, Hotel Fontainebleau, Miami Beach, Fla., May 4-7.

**National Fire Protection Assn.**—Annual meeting, Montreal, Canada, May 16-20.

**Illuminating Engineering Society**—National Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa., September 11-16.

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design  
by  
mc Philben**



45W wall mounted edge-lit

45R recessed ceiling mounted edge-lit



**cast aluminum  
quality**

mc Philben's 45 line edge-lit directionals are designed to blend with the finest contemporary decor in hotel lobbies, auditoriums, office buildings, schools and other public locations.

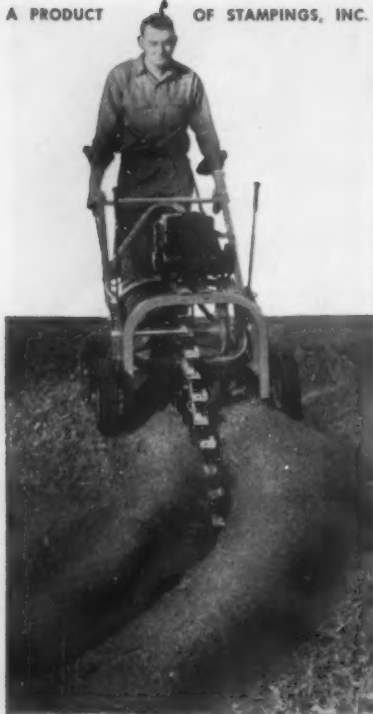
Gleaming satin finish . . . solid cast aluminum construction . . . wall, ceiling or surface mountings . . . incandescent and fluorescent models . . . invisibly hinged access doors . . . flush fasteners . . . acrylic Plexiglass inscription panels illuminating full length of letter . . . these are some of the features making mc Philben's 45 line edge-lit directionals the architect's first choice for use in the nation's finest buildings.

The 45 line series is available with either "exit" or special wording inscriptions. 4½", 6" or 8" lettering with red, green and white color combinations conform with all local regulations.

Contact your mc Philben representative today for full details. See our insert in Sweet's file 12 or write for data sheet E/1.

**mc Philben**  
LIGHTING COMPANY

1329 Willoughby Avenue  
Brooklyn 37, New York



**THIS TRENCH IS COSTING ONLY 1 CENT PER FOOT**

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**POW-R-SPADE**  
TRENCHER

Unsolicited performance reports from actual users state that POW-R-SPADE narrow trenches cost only 1 cent to 3 cents per foot, including labor. (Many report much less than 1 cent per foot.) Digging speed varies from 1½ ft. to 17 ft. per minute depending on soil conditions. POW-R-SPADE is light, rugged, with minimum of maintenance. Shipped completely assembled. Neat, fast, professional trenches—3 in. wide to 24 in. deep, or 4 in. wide to 18 in. deep. Send coupon today.

One man can transport from job to job.



Stampings, Inc., 321½-24th St., Rock Island, Illinois  
Please send material on POW-R-SPADE:

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COMPANY \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_ STATE \_\_\_\_\_

## Among the Manufacturers

### Headquarters Announcements

Penn-Union Electric Corp., Erie, Pa., has purchased Western Insulated Wire Co., Los Angeles.

George C. Borthig Co., Inc., East Rutherford, N. J., has been purchased by Standard-Toch Chemicals, Inc., Staten Island, N. Y., and will be operated as a wholly-owned subsidiary.

Triangle Conduit & Cable Co., Inc., New Brunswick, N. J.—Milton W. Gunkle, director of purchases; John B. Glenfield, Jr., assistant to treasurer—project co-ordinator.

Sylvania Electric Products, Inc., New York—Leslie H. Warner, member of the board; Robert E. Kenoyer, controller; David G. Christie, director of industrial relations.

General Electric Co., Schenectady, N. Y.—Ralph A. Huwe, manager, technical and engineering administration, ballast department.

Mears Electric Circuit Breakers, Inc., Portland, Ore.—B. C. West, general sales manager.

Minneapolis - Honeywell Regulator Co., Minneapolis, Minn.—Dr. Finn J. Larsen, vice president in charge of research.

Square D Co., Detroit, Mich.—C. M. Michalski, corporate advertising manager.

Standard Wire and Cable Co., Los Angeles, Calif.—Lawrence O. Seerden, general sales manager.

Day-Brite Lighting, Inc., St. Louis, Mo.—John E. Gornet, manager, Custom Design Dept.

Sprague Electric Co., North Adams, Mass.—Frederick R. Lack, director.

Burndy Corp., Norwalk, Conn.—Marvin Lee, president; Bern Dibner, chairman of the board.

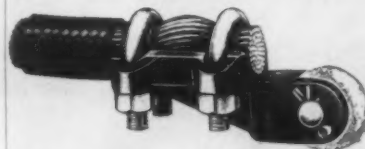
Robertshaw-Fulton Controls Co., Columbus, Ohio—Thomas A. Smith, sales manager, Acro Division.

National Electric Div., H. K. Porter Co., Inc., Pittsburgh, Pa.—Kenneth C. Crain, Jr., works manager; Robert Johnson, director of engineering; Everett L. Kimball, steel engineering manager; Robert A. Ditchendorf, industrial engineering manager.

Noma Lites, Inc., New York—Jerry Finkelstein, vice chairman of the board and chairman of the executive committee.

## "EFFICIENCY" Cable Strain Clamp

WITHOUT DAMAGE TO CABLE

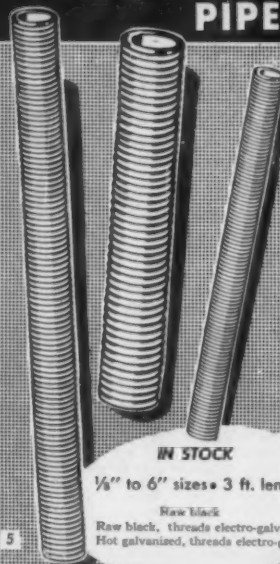


... WITHSTANDS  
DIRECT PULL OF 17,000 POUNDS

Efficiency Cable Strain Clamps lock cable safely and securely without possible strain or damage. "H" construction of clamps and high ridge across center of cable prevents cable from slipping. Takes cable from 1/0 to 1,500,000 c.m. Three clamp sizes cover all cable sizes. Furnished with eye or clevis, for AC or DC service.

**EFFICIENCY**  
ELECTRIC & MFG. CO.  
EAST PALESTINE, OHIO

## RIGID Conduit RUNNING THREAD PIPE



IN STOCK

1/8" to 6" sizes • 3 ft. lengths

Raw black  
Raw black, threads electro-galvanized  
Hot galvanized, threads electro-galv.

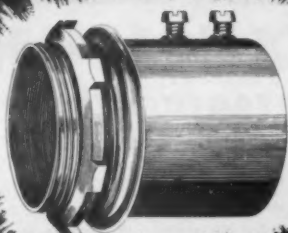
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**CONDUIT NIPPLE MFG. CO.**

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NOW...all  
ETP  
fittings  
are

**Chromate Plated**  
FOR LASTING  
PERMANENCE!



...AT NO INCREASE IN PRICE!

**Concrete tight! Every size connector and coupling up to 2". Why settle for ordinary fittings when ETP gives you all this:**

- New sparkling Zinc Chromate over-plating for lasting permanence. Salt spray tested to retard corrosion.
- Exclusive pre-set, deep-slotted STAKED screws. No backing out for conduit.
- Concrete tight with heaviest gauge wall thickness. U.L. file card E24788.
- Precision bevelled edges with extra heavy duty locknut.
- One piece solid tubular steel—cannot open or spread. Sized for uniformity.
- Available in 1/2", 3/4", 1", 1 1/4" (one screw type) and 1 1/2" and 2" (two screw type)

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I-T-E Circuit Breaker Co., Philadelphia, Pa.—Maxwell L. Stoughton, national sales specialist for outdoor power circuit breakers.

Okonite Co., Passaic, N. J.—C. D. Ham, manager—plans, programs, new and special products; Herbert N. Bush, factory sales manager of rubber, plastic and varnished cambric cable; Ray J. Wynne, manager, tape department.

Blackhawk Industries, Dubuque, Iowa—Don O. Leopold, general sales manager.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Maurice F. Corcoran, application engineer, electrical application department.

Fullman Mfg. Co., Latrobe, Pa.—E. Russell Myers, vice president in charge of operations.

Delta-Star Electric Div., H. K. Porter Co., Inc., Chicago, Ill.—Theodore C. Vogel, advertising manager; Gerald E. Martin, product sales manager of industrial products at Electric Service Works.

Kaiser Aluminum & Chemical Corp., Oakland, Calif.—R. J. Harrison, division market sales manager; E. K. Matteson, manager of utility sales; J. G. Johnson, manager of industrial sales—all with Electrical Conductor Div.

#### Regional Appointments

##### NEW ENGLAND

Allis-Chalmers Industries Group: John J. Nolan, representative in Boston.

Universal Mfg. Corp.: Joseph Fishman, special sales representative for New England.

##### MIDDLE ATLANTIC

Delta-Star Electric Division: William McNulty, Jr., district manager of new sales office in Syracuse, N. Y.

Allis-Chalmers Industries Group: Walter E. Blankley, representative in Philadelphia; Gerard F. Moran, representative in Rochester.

Prescolite Mfg. Corp.: Glenn G. Gulvin, eastern sales and service representative.

Insul-8-Corp.: J. D. Diamond, eastern sales manager, office in Washington, D. C.

I-T-E Circuit Breaker Co.: James E. Bevan, manager of New York district sales office.



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# Latrobe Electrical Products



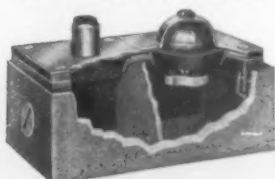
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It is 2 1/2" deep, with a 3 1/2 inch opening—large enough for the hand to fit into—which enables inside attachment of conduit without removing box body cover.

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**Stromberg Time Corp.:** William H. Riethmiller, branch manager, Pittsburgh office.

### SOUTH ATLANTIC

**Furnas Electric Co.:** Robert W. Chapman, sales representative in North and South Carolina, office in Charlotte, N. C.

### EAST CENTRAL

**Alfis-Chalmers Mfg. Co.:** Roy E. Goodwill, Jr., manager, general products division sales, central region; William R. Carlyon, manager, general industrial sales, Detroit district; James McInnis, Jr., sales representative to Mobile, Ala., district; T. F. Armbruster, sales representative in Columbus district.

**Carol Cable Co.:** Richard L. Haligas, midwestern district manager, office in Glen Ellyn, Ill.

**Furnas Electric Co.:** Joseph H. Fallon, Cincinnati, representative in southern Ohio and northern Kentucky.

**Accurate Mfg. Co.:** Ross D. Thomas Co., Memphis, agent in western Tennessee, Mississippi and Arkansas.

### WEST CENTRAL

**Kaiser Aluminum and Chemical Corp.:** J. A. Leuver, north central regional manager; R. L. Kuemmerlein, Kansas City regional manager—both with Electrical Conductor Div.

**Accurate Mfg. Co.:** R. L. Brewer Co., Inc., agent in southwest Texas and New Mexico.

**Plymouth Rubber Co.:** Bert Nott, representative for Tape Div. in Arkansas-Oklahoma territory.

**General Electric Co.:** Richard W. Morefield, Houston district manager, assemblies and component sales.

**Radio Corp. of America:** Electronic Associates, Inc., Midland, Tex., representative for mobile communications equipment in West Central Texas.

**Union Metal Mfg. Co.:** James S. Boggs, branch manager, west central district office, Kansas City.

**I-T-E Circuit Breaker Co.:** Thomas D. Williams, manager of Minneapolis district sales office.

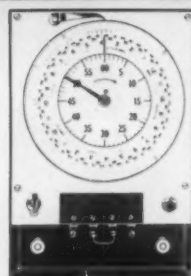
### WEST

**Clayton Mark & Co.:** Kenneth B. Schumann Co., Denver, representative for Conduit Div. in Colorado, Wyoming, and Utah.

**Prescolite Mfg. Corp.:** William Govan, sales order manager for eleven western states.

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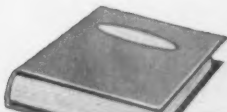
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